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Computer Age

MARCH 1991 ISSUE 18 60p

- Surveyor's solution
- Forecasts for the 80s & 90s
- WORDSTAR
- Structured programming
- Graphics

Book Extract: "Mindstorms"

MicroCentre introduce . . . . . .　CROMIX

Cromix is Cromemco's new multi-user multi-tasking high speed disk operating system It is modelled on Bell Labs Unix operating system widely available for the popular PDP-11 range of mini-computers Cromix is capable of using hard disks and floppy disks in a 1 to 6 user environment At present it supports multi-user Structured Basic Fortran IV Ratfor Macro Assembler and screen editing

Ed Hall is one of Cromemco's top systems designers Here he puts Cromix through its paces using a System Three in a 4-user configuration providing up to 63k per terminal

Efficient

The internal structure of the Cromix operating system optimises input/output buffering making disk-intensive execution more than twice as fast as most other micro-computer operating systems For instance Cromix usually runs CDOS programs faster than CDOS by utilising a simulator which intercepts CDOS operations and translates them into more efficient Cromix function calls

Flexible

Users can maintain individual sets of directories and redirect I/O to achieve system flexibility Cromix supports single and double sided floppy disks and up to three hard disks These features provide a new standard of system performance seldom found even in larger mainframe operating systems

Norman Rouxel MicroCentre's Managing Director illustrates a point about the use of Cromix to simulate a PDP-11 system running Unix in time-sharing mode

Cromix features

- Hierarchical directories
- Compatible file device and inter-process I/O
- Large number of operating system buffers
- Disk addressing to over 1000 Megabytes per spindle
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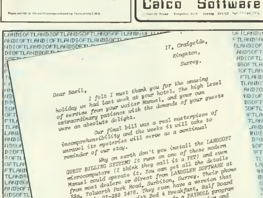

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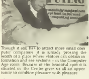
Cover **Master of All He Surveys**
by William Stok

Editorial

Two Great Ideas

The Centre
The photograph shows Sir Keith Joseph talking with Graham Clifton of Transam at the National Microprocessor and Electronics Centre in London. The Centre is a permanent exhibition of small computers and electronics



Though it still has to attract more small computer companies it is already proving the worth of a place where visitors can obtain information and see systems – in the Computer Age room. Because of the beautiful spot it is situated in the Centre gives us all an opportunity to combine pleasure with pleasure

The Grass Roots
Personal Computer World has recently started Computer Town UK! (CTUK!) which is an enthusiastic attempt modelled on the American one to spread computing among children and the uninitiated to spread computer literacy. It may be that this attempt will have more permanent effects than those that so far have been made top downwards. Whatever happens David Tebbutt editor of PCW is to be congratulated on an idea that's good in every sense of the word

Meyer N Solomon
Editor

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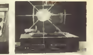

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The 80s and the 90s

Part I: Opportunities And Trends

Dr Earl Joseph is with Sperry Univac Division, Sperry Corporation. The views expressed in this paper are not necessarily those of Sperry Univac. The paper forms a chapter in the book **Future Imperfect,** *edited by Rex Malik. © Sperry Univac UK 1980. It has been further edited.*

This paper extrapolates science fact for the next 100 years, rather than dealing with science fiction. From these trends, it discusses some specific futures relative to computers and society for the 1980 and 1990 decades. Computer systems and technology developments for the 1980s are expected to split along a multiplicity of lines – some revolutionary new directions are expected to emerge as well as evolutionary advancements of past trends are forecastable. Further, there is increasing forecasting evidence that future computer systems will be far more revolutionary in nature for the late 1980 decade, and the 1990s than for the evolutionary developments expected in the early 1980s.

Social Problem	Impact on Future Computer Design	Social Impact of Future System
Requires Experts	Convivial System	Friendlier and easier to use
Faults and Errors	Fault Tolerant Self Repairable Fail-Safe	Error-free operation
Unemployment Myth of Automation	Scenarios of Desirable Futures (from computer usage)	Opportunities to generate a higher QOL for society and more jobs
High Cost of Hardware and Software	Micro systems, VLSI/VHSI. Software cost in Hardware and Software Engineering	Lower cost computing — Displacement of people — Smarter computers and smart machines

Fig A

Many factors including rapid semiconductor technology advances, movements into VLSI (very large scale integrated circuits), VHSI (very high speed integrated circuits) and beyond, smart machines applications, office-of-the future trends, further application diversity and widespread proliferation resulting from considerably lower cost hardware, and many other technological advancements suggest the forcing of a multiplicity of changing patterns. That is, the future of computers is largely technology driven. However, forecasts based solely on the technological superiority of new and/or rapidly advanced technology could be grossly misleading and miss the mark for the future. Many societal forces for further change or stability such as energy crisis considerations, growing worldwide political pressures and competition, new government policies and regulations, management and public acceptance of change, and others, all point toward altering the patterns of rapid technological change – that is, many non-technological trends impact directly on which course technological innovation will be encouraged, or discouraged, toward developing. In the main, however, many non-technological considerations can often in retrospect be shown to be technology speed-up factors – as is the case for the opportunities spawned by the many new computer applications resulting from the energy crisis. Conversely, in the short term, non-technological problem considerations can considerably slow the introduction of new technology and new systems.

The new computer revolution developing, one that is measurable in picoseconds, sub-microns and component systems, variously called the 'silicon revolution', 'micro revolution', 'information age', etc, can be forecasted to develop even faster in the 1980s. We are at the threshold of next generation technological developments for ushering in a new 'knowledge processing' era which goes far beyond the information processing and data processing eras now underway.

Opportunities and problems

Primarily, the technology influencing factors and opportunities emerging and forcing new computer developments in the 1980 decade and beyond are covered here. Since no discussion of future computer developments is possible without examining technology trends, much of what follows deals with expected hardware technology future and the alternatives. However, software and societalware increasingly paces the development of future computers and their applications, therefore, some trends in these important areas are also covered.

But perhaps more importantly, as computers become smarter and move toward 'people amplifier appliances', cultural considerations can be forecasted to become paramount – though this paper will only touch upon such cultural considerations.

Some new directions for computers were initiated in the 1970s – microprocessors, the silicon (chip) revolution and the office-of-the-future are but three from a longer list. Further advances in these key areas, and others, will be mapped for the future in this paper. Additionally, in the 1980 decade new ground will be broken as the computer field revolutionarily bifurcates along some new directions – some of these will also be outlined as 'future history' in what follows, together with a forecasted trend as they are expected to evolve.

However, rapid advances in the computer field are developing a great multiplicity of directions, and thus this paper dealing with the long range outlook in computer developments can only touch upon a few of the important directions that the future will follow. Many others will be equally important.

There are today a number of negative social aspects of computing that are currently impacting future computer design, some are:

- Experts required
- Errors and faults (hardware and software)
- The creating 'unemployment' myth of automation (the displacement of people problem)
- High cost of hardware and software
- Invasion of privacy

Each of these and others are creating, once a computer system is designed and in use, certain problems, taboos, and forbidden zones of usage. If ignored, these no-no's cause certain sections of the public to react adversely to computers – and in some cases cause laws to be passed limiting or controlling what can be done (and how) with computers In turn as these no-no s become visible to computer designers and managers applying computers systems tend to be designed to avoid or eliminate the future possibility of their occurrence

For example (see A)

Trends in technology

Almost from the beginning of transistor usage in the modern computer era an unbroken trend has been maintained for significant improvements in hardware technology and the cost performance of each new computer system introduced Advancements in the fundamental underlying semiconductor technology are expected to continue throughout the 1980s, along the trend trajectory started in the early 1960 time-frame and which has become well established in the 1970s (see **Figures 1 and 2**) Therefore, measurements of the coming decade using this technological advance pipeline as a yardstick, point to forecasts of tremendous change – and further proliferation of computers and their usage resulting from continued technology driven price erosions together with computer system performance enhancements The capabilities and application of semiconductor chips ten years from now will go far beyond what is currently being anticipated by most engineers Extrapolated trends of some expected short range future revolutions (**Figure 1**) and long range future computer developments are shown (**Figure 2**) together with a look at forecasted computer microcomponent complexity trends

Futures

The four short range future computer revolutions, shown in Figure 1 now visible for the 1980s are mapped as to their expected leading edge of occurrence major characteristics and the resulting impacts for society and computer systems are

1 The component processor revolution already begun starts with providing a basic building block for computers and communication systems, next generation LSI and VLSI hardware intelligent or smart machine products people amplifier appliances and digital automation for embedding in other machines to make them smarter Eventually this will result in such components also becoming end products

2 The component computer revolution is forecastable to start in the 1981 83 period It provides the basic component for systems made from VLSI and VHSI hardware and a progressively larger component computer envisable throughout the decade It will be the era of universal (rather than general purpose) computer products and hard program products leading to intelligent data management systems and communications subsystem components This development causes most computers to become components

3 The component memory revolution forecast for a 1983/85 introduction kicks off with a basic memory building block for information systems distributed memory a system component for revolutionizing communications information appliances a smart database computer and knowledge based systems This results in memory becoming components and could allow offices and schools to become portable machines some time in the 1990s

4 The component systems revolution forecast for a 1985/88 introduction (with special applications early in 1980/81) is initiated with silicon wafer component systems which further revolutionize institutions – leading to the possible demise of mainframe computers – and allows factories to become machines in the 1990s It will be the era of 'system on a wafer' technology there will be communications substitutions for travel and buildings and the forecasted information society will emerge Thus is future technology predictable

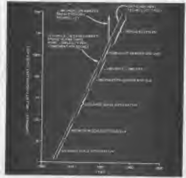

Figure 1 Computer/Micro Complexity Trend and Future Revolutions—Comp[illegible] Computers

From macrosystems to microsystems, an economy of-scale (EOS) flip-flop components become end products machines/computers become components and factories/offices become machines These major technological transitions are now forecastable and technologically feasible for the 1980s

Computer evolution is increasing tenfold every decade (see Figure 2) chip technology at 100 times per decade, while innovation is going at 1000 times per decade What will happen to chip technology when it 'crashes' into the computer curve? Will it bend toward the computer curve or will computers move onto the technology track? The answer is yes – to both questions!

New directions in microsystem technology will result in cybernetic machines intelligent machines people amplifier devices with para expert adjuncts information appliances and microfactories or distributed factories

A future history map from the 1980s also brings human cybernetic people amplifier appliances, knowledge-based systems and robots In the 1990s, from extrapolated technology trends we can expect even smarter machines, world-linked robots and people amplifiers while in the next century, perhaps, slaves for robots!

Safe predictions for the next phase of semiconductor integration developments include VLSI and VHSI passing from tens of thousands of logic gates per chip into and beyond the hundred thousand range – perhaps even by the midpoint of the 1980s decade The ever present obstacle – which always exists five to ten years before a future technological event becomes a reality – is the current question of 'what to do with 100,000 gate chips', this will surely be solved early in the 1980s One answer to be hinted at later, is the process of putting applications on a chip such as MIS-on-a-chip (Management Information System)

But and here is the rub three new conditions arise for our rapidly changing field First, the number of alternative applications possibilities of what to do with 100K and later million gate chips is extremely large •computers-on a-chip, •smart-machines-on a-chip •applications on a-chip •programs-on-a-chip •signal-processing-on-a chip, •compilers on a-chip •data management-on-a-chip

Secondly, the design-development investment for each is huge, both in time and cost But if more than a million copies are made of each, millions of dollars of development costs add only a few dollars to each copy

Finally the number of components of

100K gate size, even in an elastic market is quite a bit less (than previous chip components in the LSI and MSI ranges) for each design – but, more in total for all usefully possible 100K gate chip application designs

When these force factors for the future are combined they suggest that VLSI, VHSI, and BHSI (Beyond VHSI) should have much longer lives than MSI and LSI hardware – both for their use in systems, as well as for their design life viability as primary components of future systems

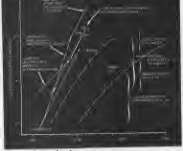

Figure 2 Silicon Revolution Future Forcast

Another forecastable obstacle and perhaps the biggest problem area, is the software problem – e g it is the stretch out in time imposed for the design of 100,000 gate chips – the Computer Aided Design (CAD) problem That is, the pacing element is the catch up game required by CAD developers and program developments, to keep pace with rapid semiconductor technology developments Here again if VLSI or VHSI truly turns out to have a longer life so should the resulting CAD and Operating System (OS) support systems

With tens of thousands hundreds of thousands, and millions of logic gates per component – as with even a few thousand per chip – there are long design times Because of such long design times the component hardware for new computer systems for initial use early in the 1980s is already in existence on designers desks Further the design development time for computers – large or small – is even longer and a serial add on to the design time for the basic hardware components Computer systems for the early 1980s thus have already had their design cast in the prints In fact, the time from the technology design inception of a new computer system to its first real usage/impact is well beyond five years with common (or peak) usage not occurring until near the tenth year by the twentieth year, it is still a usefully viable system – and this time-scenario is expected to grow longer

Thus interestingly, even in the face of an increasing pace of technologically innovative developments in the underlying component technology computer systems using such technology are tending to stay around longer as part of the technological fabric of society This implies that ●(1) there is a considerable growth in the batching of computer function innovations and ●(2) there are a growing number of technologically backward (but not necessarily obsolete) computer systems in use and that more are forecastable for the future

For some applications – especially in colleges and universities research applications the military – the hardware in use is inadequate relative to what technological advances would allow to be available For most others perhaps the major number of applications, such computer systems using older (out-of-date?) technology are entirely adequate and desirable from the viewpoint of the system stability implied But for the former applications what is implied is a vast updating and revamping of computer systems for the mid-1980s or sooner The successes from such computer developments will certainly impact upon all other areas of computing by creating more cost/performance-effective computer systems

Thus some time in the 1980s we must forecast a turning point that has already been initiated from the component viewpoint it is the US government's VHSIC program scheduled for its first impact in the 1983 to 1985 period – with numerous computer developments expected to follow This computer hardware technology advance is adding analogue (signal processing communication, and sensor) circuitry side by side with digital logic and memory – resulting in an entirely new type of hardware for designers to design next generation computers

Thus, even though we must forecast that early in this decade computers will (only) be evolutionary enhancements of present-generation computers, we also must forecast for its latter part, revolutionary computer developments – but perhaps not until almost the 1990s, unless non-technological factors cause a speed up of the introduction of such advanced technological developments

As computers become more automatically "cybernating" devices, in the form of appliances for 'amplifying' people increasingly they will be called and characterized as ethnotronic – a coined word pieced together from ethnic and (elec)tronic roots Why? Such purposive appliances (tools for helping people) possessing communication capabilities meshed with computer/cybernetic "smarts" will establish a sort of ethnotronic culture – an electronic culture wherein ●(1) people communicate with appliances, ●(2) appliances trigger conversations with people to make the person they are amplifying 'currently aware' and ●(3) appliances 'talk' with other machines for the purpose of "amplifying" the person served Additionally, such amplifier appliances, in their own cultural ways, will supply/support many other human needs by performing certain (broadly) information related or knowledge and decision assistance based tasks themselves in order to perform their role within society

Additionally breakthroughs in mass storage technology, in this decade, will see the creation of very large, computer stored data bases economically feasible for even small organizations – orders of magnitude larger in capacity, and at least an order of magnitude less costly There is no doubt that a one to two orders of magnitude drop in mass storage costs will have profound business and societal effects quicker movements into the information society, higher economic productivity massive jumps into the paperless future-office-of-the future, real time and life-long educational systems knowledge (instead of data) based computer systems, and much more including business and society infrastructure changes

Such advances in mass memory development are now clearly in store for the 1980s and before 1990 we should expect even more ■

● *To be continued* **Next issue** ●*Future generation calculators* ●*Future office-of-the future* ●*New directions in microsystem technology* ●*Software cast into hardware*

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Without a doubt, Apple Computer's public offering of 4.5 million shares of stock is the most exciting event on the already exciting U.S. microcomputer scene these days. And unlike news of, say, a new software package, Apple's stock harvest garnered attention in quarters normally unaccustomed to talk of bits and bytes.

As an example, the following, a conversation overheard in a Wall Street tavern. Two men, dressed for business but with ties loosened as befits the end of a long day, sit at the bar, hunched over their drinks.

First man Hey, can you get me a piece of Apple?

Second man What are you talking about? What's Apple?

First man Whadd'ya mean, what's Apple? It's hot, that's what! It's big! Can you get me some?

Second man Yeah, sure. What can you tell me about them? What does this Apple do anyhow?

First man How do I know? Something with computers, you know. But big money is going to fly. Jeez, if I could only get my hands on a few hundred shares!

And so on. These conversations have been going on since last summer, when word first got out that Apple was, in the parlance of the bulls, bears and other creatures of Wall Street, "going public."

Well, the big day, December 12, came and went and the Apple stock sold swiftly. That day, the stock closed at about $29 per share, $7 over the opening price of $22 per share. As 1980 rolled to a close, the stock was about $35. Not bad.

Not to be lost in the shuffle is the fact that the offering of 4.5 million shares represents a very small piece of the company's outstanding stock. To be precise, about 9 percent of the total 52.4 million shares. Many shares, about 25 million, are held by the company's three top officials; the rest is owned by interests including the Rockefeller venture capital group, Venrock; Xerox Corporation (which has been rumored to have considered buying up the company lock, stock and memory), and others.

Well, for investors and stock analysts there really isn't a lot more to tell. But for users of Apples, as well as for the micro industry as a whole, the story has just begun. First of all, how, if at all, does the Apple public offering affect users of the company's computers?

Right now, the plain answer is: Nobody knows. If somebody does, he's not talking.

But a few things do seem certain. One, the company will continue spending a lot of money advertising its wares. Remember, in 1980, Apple spent some $4.47 million blowing its corporate horn. The net result is that Apple will become even better known than it is today. And that means more conversations like the one we overheard.

Perhaps the greatest effect will be on the microcomputer industry as a whole. There is no question that Apple's stock offering did more to publicize micros than did any other event or promotional campaign of the last five years or so. And that's about how old the business is. As a result, micros are becoming even more of a household word.

Of course, a great deal of the publicity arrives to Apple alone. The company is becoming, at least in the public's mind, the IBM of micros. In other words, one and the same.

A few possible scenarios suggest themselves. In one, IBM and a few other biggies finally take their cue. They stop fooling around, introducing micros with better hardware, better service, better software, better everything. Bye bye Apple, Radio Shack, Commodore and all the rest.

In another plot, Apple takes over the micro business, or at least most of it, for itself, risking antitrust suits galore. Again, just as IBM has done in the mainframe business.

And in a third version, the U.S. micro business blossoms and everybody gets rich. Everybody is happy and nobody is without a computer and...

Then again, maybe it's time to go back to the bar. As our beer-soaked bear almost asked, what does Apple plan to do with all that money anyhow?

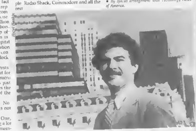
Rumors abound. And in what may be a sign of things to come, Apple is doing little to straighten out these murmurings. Instead, they're busy perfecting their IBM imitation, with lines like "It's not our company's policy to discuss future plans." Very well. Let the rumors fly.

One possibility the grapevine whispers is that Apple develops some sort of local network feature for Apple micro users. In actual fact, at least one financial institution in New York is assembling such a network on its own. Surely, the idea has not been lost on the folks at Apple.

Another story involves visions of the Apple IV. It seems that the basic machine would cost about $10,000 but would be truly expandable. That means that nobody gets away for only $10,000.

In the meantime, the Apple III has been nothing but trouble. No one likes to hear this, least of all Apple's public relations firm. But a machine scheduled for deliveries last summer was just reaching the dealers in December (1980). And to make things worse, the machines don't work. Hopefully, by the time you read this, the company will have sorted out whatever ails the III. Everybody hopes so, particularly the few investors that might actually know something about the business. ■

- *By special arrangement with Technology News of America.*



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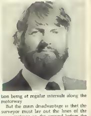


This account of a question and its answer obtained by a fresh piece of thinking is a good example of action learning or lateral thinking

Civil Engineers and Surveyors often wish to calculate the volume of large irregular shapes This is a problem which typically occurs in a large civil engineering project, such as the construction of a motorway or a dam As the earth moving company (or 'muckshifter') whose bid has been accepted will have contracted to move the earth at so much per cubic metre, accurate calculations are essential

The first part of the process is the measurement of the irregular mass This is accomplished by surveying techniques, measuring the earth in its virgin state as a set of sample heights above a datum, usually standard sea level Each of the height measurements must also be located horizontally and although these measurements are known in surveying jargon as eastings northings and levels it is more convenient to talk of them here in the mathematical convention of x, y and z

In order to simply the task of calculation, the horizontal x y positions at which these sample heights are traditionally measured are regularised in some way

One way in which this is done is to lay out a grid of lines in the x and y directions on the ground, and to measure the z (height) ordinate at the intersection of each crossing pair

This method suffers from three disadvantages firstly, the surveyor has to go to a lot of trouble to lay out the grid of lines on the ground, secondly, the ground is modelled with a uniform density of sample points regardless of its local detail, and thirdly any critical point for the calculation (say the corner of a hole which has to be dug) must be interpolated from the adjacent points, unless, of course, it happens to coincide exactly with one of them Whilst the first disadvantage is merely one of convenience the second two do in fact affect the accuracy of the subsequent calculation

Another method often used for long narrow earthworks, such as motorways, is to measure the z ordinates at 'cross sections' These are lines running across the motorway and square to its centre line Although the positions of the points on the cross sections may be varied according to the detail of the terrain there is still the disadvantage of the cross section being at regular intervals along the motorway

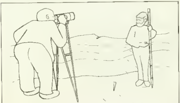
But the main disadvantage is that the surveyor must lay out the lines of the cross sections on the ground before the measurements can be made, and usually at a time when the alignment of the motorway is not yet known accurately

In the early 1960s I was working on a project to write computer programs for road design We decided that the best way to model the ground was to measure its height at points chosen *freely* by the surveyor in order to model the terrain with the best combination of accuracy, economy, and ease of surveying A great deal of thought was given to converting this irregular data into suitable form for use in the computer programs, but eventually we finished up with a rather unhappy compromise of interpolating a square grid of data from the 'random observations' and in turn interpolating cross sections from this grid[1]

Of course the method was largely dictated by the speed and size of the computer we were using in those days as the data stored in the grid form could be retrieved directly from the backing store without examining each item to see if it was appropriate

During our discussions we toyed with the idea of defining an irregular set of *triangles* formed with their *corners at the data points* The terrain would thus have been modelled as a set of triangular planes which would have given us a much more accurate picture Even without the physical restrictions of the computer, we could not conceive of a satisfactory system for deciding *which* points were linked by *which* triangles and for many years it has irked me to know that an apparently simple problem existed which I couldn't solve

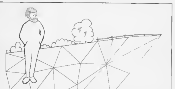
Last year I wished to test the potential of a new microcomputer by means of practical field trials, and one of the things I wanted to find out was how difficult it was to develop a new FORTRAN program of some complexity The triangles problem seemed to be an ideal subject, as I had no preconceived notions of how it might be done and therefore would be working absolutely from scratch Fur



'The surveyer has to go to a lot of trouble to lay the grid of lines on the ground'

thermore, the economies of being able to input "random observations" have changed over the years due to the impact of modern electronic surveying instruments. This made a triangulation-based earthworks program even more attractive.

Like many engineers, my mathematical abilities are strictly related to the solution of practical problems, and it was highly unlikely that I should achieve a rapid solution by researching the mysterious mathematics of topology. On the other hand, I knew that, given a pencil and a piece of paper (without which any engineer is hopelessly incapacitated), I could


"The terrain would thus have been modelled as a set of triangular planes."

construct a perfectly satisfactory set of triangles to fit any random set of points.

I spent several evenings doing this, peppering a sheet of paper with dots, joining them together systematically, formulating the rules which enabled me to do this, and then repeating the problem in strict obedience to the rules I had formulated. These looked something like this:

1 Choose any point.
2 Has it any lines associated with it? If so, choose the shortest one; if not, choose the nearest point to it.
3 Is the line joining these two points already in more than one triangle? (If it is already in two triangles, it cannot form the basis for a third.)
4 Rank the remaining points in order of suitability according to some empirical rule.
5 Work through the points in order, checking that the lines forming the triangle do not cross any existing triangles' sides

and so on.

Rules into program

Turning these rules into a FORTRAN program was sometimes quite intriguing. For example, how does one decide when a point is *inside* a triangle? Thinking in the physical or visual terms which come easiest to an engineer, I concluded that one "walked round" the triangle in a clockwise direction, and if the point was always on one's right, then it was inside the triangle. In programming terms this means calculating the angle between the

Earthworks Calculations

line joining the point to a corner of the triangle, and the line joining that corner to the next one in a clockwise direction. A sign convention of right-hand angles being positive is adopted for this angle, and if each of the three calculated angles is positive, the point is inside the triangle.

Building up a complete system of triangles in this way did not prove to be too difficult, but, although it was possible to ensure that every point was included in the system, it was not possible to ensure

"Formulating the rules ..."

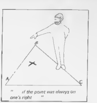
that the system had no undefined "holes" in it by this method alone.

The operation had to be concluded with a more systematic search to see if any line joining any two points could be made into the side of a new triangle.

This yielded a satisfactory solution, but when the number of points was increased from the nominal test data to accommodate real life problems, I found to my consternation that the processing time increased appoximately as the cube of the number of points!

Returning to my heuristic approach, why did my own time only increase linearly?

It seemed to me that, as the data was laid out on a piece of paper, I could *look*



"... if the point was always on one's right ..."

at a small area and only have to contend with a limited number of points at one time.

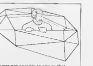
The program was therefore reorganised so that it worked across the data field in small patches, dealing only with the points in one patch at a time. When all the possible triangles for a patch had been found, they were written to a file and only a list of the lines forming their external boundary was retained. The next sub-set of points was then read, another set of triangles created to link them and the previous boundary, and the boundary was then extended to encompass them all. This produced the desired effect of having reasonable processing times for large data fields.

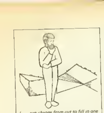
The practical problem

• It was now time to get down to the practical problem of calculating actual volumes of earthworks from the triangular pattern of planes.

To do this, each triangle has to have two sets of z ordinates, one for the existing heights of the ground, and one for the new height which is to be formed by the earthworks. The heights could no longer be associated with the points themselves, since each of the triangles meeting at a point could have a different height at that corner. The program then examines the triangles in turn, treating each as a vertical prism with end planes defining the position of the existing ground and the new work.

The calculation of the volume of this prism is comparatively easy, but is complicated by the fact that in a typical earthwork calculation the condition can change over from cut to fill within one triangle. That is, the height of the new


"It was not possible to ensure that the system has no undefined holes in it."



"… can change from cut to fill in one triangle"

ground at some corners of the triangle, while being above the existing ground at others. This problem solved, it is only necessary to add together all the volumes of 'cut' and all the volumes of 'fill' to achieve a correct value for the total quantity of each to be moved.

The actual earthwork to be calculated is described by the user as a series of polygons, or irregular figures with any number of straight sides. These are input as the x y co-ordinates of the points at the corners, together with the z ordinate of one, two or three corners. If only one is given the new work is considered to be finished on a horizontal plane, whereas for two or three points a tilted plane is calculated. The program then checks each of the triangles constituting the model of the existing ground.

When the sides of the polygon cross one of the triangles it is sub-divided into smaller triangles in such a way that the sides of the smaller triangles coincide with the sides of the polygon. The new triangles receive their 'existing' z ordinates from the plane of the original triangle, while the new ordinates are obtained from the plane of the polygon describing the earthwork. Only those within the polygon are, of course, given these new values.

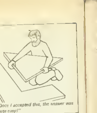
In addition to the general case of the polygonal shaped earthwork, facilities to input two special cases are provided: the first is a simple rectangular shape with its sides parallel to the x and y axes of the model. This simplified shape forms a

Earthworks Calculations

very large part of the type of input which most engineers require as it may be used to represent the rectangular holes dug for the foundations of buildings and similar structures.

The second special shape is the side slope of an embankment or cutting. This is a frequent way of finishing off the edges of an earthwork, as the earth will not usually be stable with a vertical face and walls to retain it are very expensive. The problem here is that, while the position and height of one part of the slope (at the edge of the adjacent earthwork) is known, the other end, where the slope meets the existing ground, is not. The program is written so that only the known part of the data needs to be input and the places at which the slope joins the existing ground are calculated automatically. The resulting shape can be expressed as a polygon, which then becomes the general case already programmed.

Another interesting problem arose as a result of this second special case in deciding what is inside and what is outside of the polygon, the same approach as has already been mentioned for the triangle can be used – that is, if the polygon does not have a "re-entrant" angle. If all the internal angles at the corners of the polygon are less than 180° then the rule of walking clockwise round the figure and seeing if the point is always on the right works perfectly well, but if the figure has a *re-entrant* or *indented* angle (as for example in the case of a plan of an L-shaped building) the rule fails miserably.



"Once I accepted this, the answer was quite easy!"

I had originally intended to take the coward's way out and exclude polygons with re-entrant angles, but then I realised that the special side slope case would generate them automatically. I spent a long time looking for other rules which would handle this problem, and eventually I had to give up and admit that I didn't know how to do it. Once I had accepted this, the answer was quite easy! The program works its way round the polygon until a re-entrant corner is found. This is then filled in with a triangle, which is noted. The process continues until a new polygon has been created with no re-entrant angles. Any point which is within the new shape (which we know how to test) but is *not* in one of the new "infill" triangles, must therefore be in the original figure.

The program is now fully operational and can cope with very complicated problems due to the fact that there is no limit to the number of shapes which can be introduced, and that they can be superimposed, overlapping, adjacent, coincident or any other combination. ■

- The author is a Civil Engineer, Partner in the firm of Stirling Maynard and Partners, Consulting Civil and Structural Engineers.

He started writing bridge design programs in the early 60's on an Elliott 803, and subsequently helped to write one of the first integrated suites of highway design programs, which used an early Calcomp for graphical output.

In the early 70s he worked with the CAD (Computer Aided Design) Centre at Cambridge and wrote their first practical applications program using interactive graphics for engineering design. The Atlas II on which the work was done was one of the biggest systems at its time.

He now works with Geest Microcomputers using the smallest models of the Texas Instruments 990 range.

Bill Young directs all the engineering design work undertaken by Stirling Maynard and Partners and only spends a small portion of his time working with computers. He does not consider himself a "professional computer person".

APPLE WINNER

The Apple II system offered in the (December 1980 issue) competition has been won by Philip McCrae, of 'Hawkrigg', Holmbrook, Cumbria. Philip is a student at the University of Liverpool. The newsagent at which he bought his copy of *Computer Age* is Bob's News Box, Brownlow Hill, Liverpool.

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A National Phenomenon

The two events that established a microcomputer marketplace in the U K were the Nascom Seminar held in 1977 at the Wembley Conference Centre, and the three one day PET Seminars organized by ETI and held at the Cafe Royal in 1978 We are now three years on and it seems as if a lifetime has been packed into that period

It is fitting that it was the Nascom and the PET that got microcomputing going, as it was these two products that established the entire nature of the marketplace The Nascom appealed to electronics hobbyists as being the ultimate kit that they could assemble the challenge was in getting it working not in using it! As a result I doubt if even half the Nascoms sold are in regular use today The PET appealed to everybody because it was a single plug-in-and go unit that was very friendly to use Subsequent 'improvements' have taken the magic away but the original PET remains for me, one of the nicest computers to use

The nature of the marketplace thus established was a little ambiguous On the one hand, a lot of people became enormously competent at hardware and many of these also became adept at Z80 machine code programming, on the other hand, many people became spoilt by an easy-to-use machine which had the excellent Microsoft BASIC and they sought more power and sophistication

The advancement of microcomputing in '78-'79 was spurred on by the specialist media, notably Gary Evans at *Electronics Today International* and Meyer Solomon (then editor) at *Personal Computer World*, these two being at the vanguard of what was to become a plethora of writing on the subject This is very much in evidence in the industry today with a large number of specialist magazines in existence, the non specialist magazines constantly carrying micro-oriented articles, and the availability of an almost infinite array of book titles Seemingly, the outstanding feature of the marketplace is the vast amount of information both sought and available

Having had a brief look at the history it is time to look at what all this has developed into From the hardware point of view the most significant machines now available are the Sinclair ZX80 and the Apple The Sinclair is significant in that it is serving as an introduction to many thousands of people who perhaps would not have become interested so soon were it not for this low-cost product. That many ZX80 owners will graduate onto 'proper machines is inevitable and surely Clive Sinclair will produce a computer that will enable them to show brand loyalty when they make that move The enormous gain in popularity of the Apple over the last twelve months is a sign of the increasing sophistication of the microcomputer user The demand now is for a machine which is flexible and versatile and which can be enhanced to reflect the user's needs That Apple meets these demands with what is now an old design is a tribute to its designers for being so conceptually correct

From a software point of view there emerge two forms of software to dominate the marketplace The first is do it yourself" as users become more knowledgeable and competent and also as they overcome the psychological barrier of using a "computer The second form is a general, low cost package prime examples of which are VISICALC, Whatsit and Electric Pencil Paid-for custom software from a systems house seems to be down if not out as the disproportionate cost of developing the required program far outweighs the advantages of low hardware costs

Many companies have tried to develop software as well as sell equipment As each of these tasks requires completely different skills, I am convinced that to do both is to do both badly It is becoming increasingly evident that those companies who direct their resources to one task are those who do that task best

The U K marketplace for microcomputers has always been, and looks like being for some time, a *national* as opposed to a *local* marketplace This means a customer in Southampton is as likely to buy from a retailer in his immediate vicinity as he is from a retailer in, say, Aberdeen This phenomenon is not apparent in America and appears to be a British invention Amazingly, it applies to big micro-systems as well as to small purchases and appears to be unaffected by the proliferation of computer stores

That we have a *national* marketplace is partly a result of customer loyalty and partly a result of national advertising in the microcomputer magazines by retailers, whereas in America the advertising in the national magazines is done largely by the manufacturers and distributors or is done by a retail chain with local outlets The existence of this national marketplace is advantageous to the customer as it increases competition, thus resulting in better prices and better service

Whilst talking about retailers and distributors, it is worth mentioning the dubious business practice of distributors selling to end users If a product is to succeed it is essential that the distributor only distributes If he attempts to sell direct he is competing with his dealer and this leads to a conflict of interests It is my belief that certain computers would have been a lot more successful in this country if the distributor had refrained from direct sales ●

● *Bruce Everiss is the founder of Microdigital now part of the Lasky group* **The viewpoints of other retailers are invited**

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Darrel Ince

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COMPUTERS AT EXETER

Dr Ince is currently at the Open University working on a second level degree course M252 Computing and Computers This article is a spin off from the research he undertook during the making of a television programme which is based on the Exeter project and which forms part of the supporting materials to the course **Editor's Note** *The Project has since this article was written undertaken new developments*

The Exeter Community Health Services Computer Project

Before I visited the Exeter community health services computer project I thought that the use of computers in the health service was minimal The numbers of thick volumes of notes each detailing health service computer projects throughout the country soon disabused me of this impression The Exeter project does, however, stand out from the majority of health service applications in that it takes an *integrated view of medical data* To see what this means, examine two areas that have proved ripe for computerisation in the health service

- 1 The management of hospital waiting lists
- 2 The management of general practitioner medical records

If each of these areas had been computerised separately then there would be two separate files in existence one for the hospital waiting list area, and one for the medical records area This leads to a problem when data which is shared between these files is modified

For example assume that a patient's address has to be changed, the address is held in both files and so an update has to be applied to them both Now, if more new areas are introduced for computerisation the problem increases — it has been found in systems where a large number of areas have been *separately* computerised that data rapidly becomes inconsistent because updates are missed on some files This problem can be eliminated if a patient record is represented *once* in a single data base and *each* application area is able to access this record

Naturally this record will have to contain more data, but there is one big advantage an increase in communication between application areas

In my example of two areas with an integrated view of data a doctor would find it easier to examine his patient's position on a hospital waiting list (See Figure A)

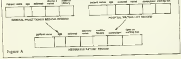


Figure A

When you are ill you can interact with any number of people and services your own doctor a hospital consultant, nurses at the hospital, the ambulance service, and testing agencies such as the X Ray department

The Exeter project took the view that almost all the points of contact of a patient with the health service could be computerised and, that since there was a big degree of overlap between data in the various areas, that one record per patient known as the **integrated patient record,** would serve as data for the various application areas The integrated patient record has led to a much greater and effective communication between consultants, nurses, doctors, general practitioners and hospital administrators

The project is regarded as a showcase for computerisation in the health service The project's pioneering efforts were recognised in 1977 by a prestigious award from the British Computer Society

History of the Project

This ambitious project's beginnings were humble enough It arose out of a small morbidity survey organised by the Institute of Biometry and Community Medicine at Exeter University the first attempt (in 1967) at Exeter to collect medical information and collate it using a computer The survey demonstrated the practicality of handling medical records by computer A number of feasibility studies and systems investigations then led to the building of a computer centre in 1972 and recruitment of staff between 1970 and 1973, and in 1974 the first systems became operational The project has been concerned since then with the addition of various applications on to the computer

The computer itself is a large ICL 1904A Users at the health centres and hospitals it serves communicate via visual display units and the response of the system is such that it is a real time application The number of areas that have been computerised at the time of writing, is quite large so I shall describe only some of the more important applications

The General Practitioner System

In order to understand why a computer can help your doctor the best way to start is to examine the papers in the NHS envelope that he uses for each patient in order to keep track of their medical history These sheets of paper have written on them dates of visits to the surgery reasons for the visits, treatment given, referrals to hospital letters from hospitals results of X-ray and chemical tests, and so on There is often so much information in these envelopes that they burst The information is often arranged in chronological order perhaps with the writing of a number of doctors Important information is often found in the middle of out-of-date unimportant information

Undoubtedly a doctor can improve his medical records However most doctors feel this takes valuable time, time better spent seeing their patients Fortunately, the processing that is required can easily be provided by a computer The best way to see how the general practitioner computer system works is to describe what happens when a patient arranges to see his G P

A patient either phones in or attends at the health centre to make an appointment The receptionist takes the patient's name and enters it on the doctor s list for a certain surgery appointment At the same time she uses a visual display unit to interrogate a patient file for the patient's unique registration number This she writes on a slip of paper for the doctor whose surgery the appointment has been made When the patient visits the doctor he uses that number to call up the patient s record on a v d u A number of screens are available to the doctor He browses through these pressing various keys on the typewriter keyboard attached to the V D U

The most important screen is the display summary It shows important clinical information that is often crucial to treating the patient It contains a history of illness a summary of medication personal details and details of the current episode (the most recent illness being treated) Figure 1 shows the display summary screen for a mythical patient who suffers from hypertension (abnormal blood pressure) and is a diabetic with an allergy to the drug ampicillin The screen shows a summary history of illnesses, and you will see that in 1964 she was

Yoshi Imamura

Jack Sparrow director of the Project with a programmer

suffering from diabetes and a course of insulin was needed, her blood pressure was 170/100 These details are followed by medicines that have been prescribed and details of the current episode which is concerned with the treatment of an ulcer on a small toe

A number of other screens are available for inspection One of these is an extension of the summary display There is a screen which gives more details of medicines prescribed, their doses, the frequency of application the amount when they were prescribed and how many repeat prescriptions are allowed

A further screen enables a doctor to retrieve details of long past illnesses which are not needed when current treatment is being given This screen tends to be used fairly infrequently and only in response to enquiries from insurance companies or law agencies

One fascinating screen I saw uses a graphical technique to chart the control of certain illnesses by medication Figure 2 shows one such screen which is concerned with the control of abnormal blood pressure It shows for the mythical patient, Mr A N Other, that her blood pressure was rather high on the date 12 01 74, being 225/125 and that having been treated with two tables of bethanidine per day her blood pressure dropped to 210/115 on 19,01 74. The rest of the screen shows the course of the blood pressure plotted against the number of tablets of bethanidine per day prescribed

You can imagine the time that it would occupy a doctor to do the same thing manually

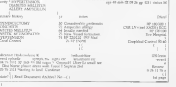
Once the doctor has finished the consultancy he uses the v d u to update the patient record and perhaps prescribe some medicine Repeat prescriptions are printed out on a hard-copy device in the reception area, signed by the GP and finally collected by the patient The advantages in using such a computer system are many

●1 The doctor doesn t have to write many prescriptions they are produced legibly and accurately The computer system also enables drug abuse to be eliminated as the doctor can set a limit to the number of repeat prescriptions printed

●2 The computer has transformed the practice of health centre management into a fairly trivial occupation Statistics such as patient visit totals and drug use totals are produced automatically

●3 A consequence of computerisation is that an adequate backup mechanism is needed in case of computer malfunction This had led to microfiche copies of patient records being kept The advantage of these microfiche copies is that they provide a much more legible and understandable record and are available at all times including a doctor's home visits where he is unable to use the computer

●4 Trivial or unimportant data can be



```
DS1 Display Summary                                                          Patient HC No(259092 )

                         OTHER  Mrs ANN NANCY  21 SCHOOL LANE  OSM
priority * HYPERTENSION                                     age 49 dob 02 09 26 gp 1311 status M
           DIABETES MELLITUS
           ALLERY AMPICILLIN
           (                        )
summary history                     yr          notes                                   DAref

APPENDICECTOMY                      50 Considerable peritonitis                  BP 180/100 1
BRONCHITIS                          72 Ampicillin allergy            CXR LV+ ref XA231) ECG
DIABETES MELLITUS                   64 Insulin needed                             BP 170/100
DIABETIC RETINOPATHY                75 New Vessel formation                    Eye Hospital
HYPERTENSION                        74 BP 220/120 IVP Nad                                 2
  Good Control                         76 BP 150/90                    Graphical Control 50 60
(                                                ( (                                {     }
(                                                ( (                                {     }

medicanon Hydrosalure K                     bethanidine                           IZS-lente
current episode          symptoms  signs etc      treatment etc                      -event
12 04 76 1111 BP 160/95 Bld sugar 5 Ointmnt Ulcer Lt small toe                            a
    Dist Nurse please dress with Eusol T Septrin 2bd                                 Review
12 05 76 1111 Starting to heal Continue                                          is 26 11 76 a
         (                                                                               ( )
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FIG 1

weeded out and deleted early This data is available but it will only be printed on an explicit command from the doctor

●5 It is easy for the computer to search through all the patient records for a particular feature This may occur when the doctor has been notified that a certain drug may be dangerous or create certain side effects It is fairly trivial for the doctor to instruct the computer to print the names of any patients that have been prescribed the drug so that he could notify them

●6 The use of graphical displays, such as the one that I have described for the treatment of hypertension enable the doctor to gain a clearer understanding of the effects of medication

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To summarise, the computer has freed the doctor from spending his time writing and organising records and this allows him more contact with his patients Although I shall describe the security aspects of the Exeter project later in this article it is important to point out that the screens displayed in this article are mythical records which make up a teaching system for the training of new staff

Security plays a very important part in the Exeter project and is under the *complete control* of the general practitioner For example the receptionists at a health centre can be prevented from seeing a patient's medical data, and can only be given access to data such as a patient's name and address – only the details necessary for them to carry out their job

The Nursing System

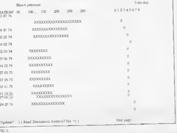
One of the clinical areas that was first computerised for the hospital was the treatment of patients in a hospital ward The Exeter project developed a system to maintain patient records known as nursing record thus has been defined by the Centre Health Services Council report as providing a running record of the nursing care given to a patient during his stay in hospital together with observations on his progress The nursing record is often found spread over work books or sheets, temperature books and Kardex filing systems, one of the main features of this record is that it has to be kept up to date The nursing record has now been added to the integrated patient record and can be interrogated by using a v d u situated in each ward at the hospitals that the project serves

One important part of the system is concerned with the provision of nursing orders These are instructions to a nurse as to what treatment a patient requires Perhaps one patient may need his temperature taken every three hours, perhaps another patient who has been confined to bed for a number of days need pressure points treating with powder and another may require preparation for an operation

All the nursing orders at Exeter are selected from a *dictionary* of standard orders A nurse signs on at a v d u and is able to see what orders are required for each patient When the treatment has been applied the nurse usually initials the order or gives a report on the treatment This is again done using a v d u As well as the v d u in the ward there is also a hard copy printer which produces, among other reports, the nursing orders for each patient for that day These are placed in each patient's case notes and they are also used as a standby in the case of computer malfunction Figure 3 shows the nursing orders for one bay of a ward in one of the Exeter's hospitals for 26 10 76

Also produced is a full record of a patient's case during his stay in hospital One copy of this record is retained in the patient's case notes and can also be sent to a district nurse when the patient is released and requires further nursing The computer helps in the administration of a ward bed occupancy can be displayed, patients can be moved around or from one ward to another, and a cumulative record of ward occupancy is kept This cumulative record is particularly useful if it is discovered that a patient has an infectious disease The hospital can trace very quickly any fellow patients who may have been in his proximity and may have caught the disease

One of the most tangible benefits to arise from the computerisation of the



```
DAt Control Hypertension                                        Patient HC No (259092    )
                    OTHER  Mrs ANN NANCY  21 SHOOL LANE  OSM
                                                                      Tabs.day
         Blood pressure
DATE/BP  50    100 ..  150    200    250    280             0 1 2 3 4 5 6 7 8
12 01 74
                  XXXXXXXXXXXXXXXXXXXXX                      0
26 01 74         XXXXXXXXXXXXXXX                              0
02 02 74          XXXXXXXXXXXXXXX                              0
16 02 74                                                        0
02.03 74        XXXXXXXX                                       0
29 06 74       XXXXXXXXXX                                      0
14 12.74        XXXXXXXXXX                                     0
07 03 75         XXXXXXXX                                      0
21 06 75        XXXXXXXXX                                      0
18 11 75          XXXXXXXXX                                    0
11 03 76         XXXXXXXXX                                     0
15 06 76           XXXXXXXXXXXXXXX                             0
09 07 76         XXXXXXXXXXXXXX                                  0
                                                                 0

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FIG 2.

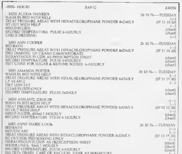
nursing record is a reduction in clerical work and a saving of time for producing a complete record that can be used in the nursing of a patient The nursing record has been centralised and is more legible It also does not contain abbreviations as a numbering system allows the selection of pre-defined nursing orders from a dictionary of standard orders

Drug Information System

One system which developed independently of the Integrated patient record, was a drug information system Drug details differ day by day, the amount of information held on drugs is large, e g one drug may masquerade behind a number of proprietary names The Exeter project devised a system whereby a doctor or nurse can enquire about a drug using either its medical name or its proprietary name Information given about the drug by the system includes indications as to when it is to be used its action precautions to be taken in prescribing, possible side effects the dosage range and how it can be administered This may seem to be a trivial application but it is highly convenient where v d u 's are installed in a ward or in a surgery

Hospital Administration System

The computer is much used in administration in the hospitals that the Exter project serves The In-patient waiting list is administered using the computer patients are registered using the computer, patient summaries are produced showing the history of visits to the hospital and identification labels are produced for case note folders X-ray folders and various specimen bottles It is one of the heaviest used systems with some 90 staff routinely using v d u 's as part of their everyday work.



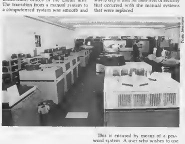
```
-0000- HOURS                               BAY G                                 AVON

  MISS ALEXIA HANKEN                                                26 10 76—TUESDAY
WASH IN BED WITH HELP                                                            (—)
TREAT PRESSURE AREAS WITH HEXACHLOROPHANE POWDER 4xDAILY                (07 11 15 20)
SIT OUT WITH HELP                                                                (—)
MIXED FLUIDS                                                                 (chart)
RECORD TEMPERATURE PULSE 6-HOURLY                                            (chart)
CHECK DRESSING                                                                   (—)

  MRS ANN COOPER                                                    26 10 76—TUESDAY
BED BATH                                                                         (—)
TREAT PRESSURE AREAS WITH HEXACHLOROPHANE POWDER 4xDAILY                (07 11 15 20)
DIET DIABETIC 120 GRAMS CARBOHYDRATE
INTRAVENOUS FLUIDS AS PRESCRIPTION SHEET                                     (chart)
RECORD TEMPERATURE PULSE 6-HOURLY                                            (chart)
TEST URINE FOR SUGAR & KETONE BODIES 6-HOURLY                                (chart)

  MRS AMANDA POTTER                                                 26 10 76— TUESDAY
WASH IN BED WITH HELP                                                            (—)
TREAT PRESSURE AREAS WITH HEXACHLOROPHANE POWDER 4xDAILY                (07 11 15 20)
UP AS ABLE                                                                       (—)
DIET LOW FAT
CLEAR FLUIDS ONLY                                                            (chart)
RECORD TEMPERATURE PULSE 2xDAILY                                             (chart)

  MISS ANNABEL GROCER                                                           -(—)
WASH IN BED WITH HELP                                                            (—)
TREAT PRESSURE AREAS WITH HEXACHLOROPHANE POWDER 4xDAILY                (07 11 15 20)
SIT OUT WITH HELP                                                                (—)
MIXED FLUIDS 400ml 1 HOURLY                                                  (chart)
RECORD TEMPERATURE PULSE 6 HOURLY                                            (chart)

  MRS ANNE MARIE COOK                                              26 10 76—TUESDAY
BED BATH                                                                         (—)
MOUTHCARE                                                                        (—)
TREAT PRESSURE AREAS WITH HEXACLOROPHANE POWDER 4xDAILY                 (07 11 15 20)
SIT OUT FOR BED-MAKING ONLY                                                      (—)
INTRAVENOUS FLUIDS AS PRESCRIPTION SHEET                                     (chart)
WATER ONLY 30ml 1 HOURLY                                                     (chart)
RECORD TEMPERATURE PULSE 6-HOURLY                                            (chart)
SUCTION DRAIN CARE OF VACUUM BANK AT 0600-HOURS                                  (—)
CHECK DRESSING                                                                   (—)

-0000- HOURS                               BAY G                                 AVON
```

Fig 3

I have only described a few areas where the computer has been used It is fair to say that the visual display unit has become a standard piece of medical equipment in wards health centres pharmacies, X ray departments and administration offices in the Exeter area The transition from a manual system to a computerised system was smooth and accepted at every level of staffing When visiting a rural health centre what surprised me was how even elderly patients who I expected to resist the intrusion of the v d u into the surgery spoke enthusiastically of 'their computer'

Security

This article would not be complete without a description of the security aspects of the Exeter project Medical records are very private things and one of the main objectives of the project team was *to keep at least the same level* of security that occurred with the manual systems that were replaced



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This is ensured by means of a password system A user who wishes to use a system is given a password which he uses when signing on at a v d u This password determines an access code which specifies which applications and files the user is allowed to access together with that data the user is allowed to read, print add amend or update If a certain number of attempts to sign on is made by an unauthorised user the project staff is notified and security precautions are increased to detect the malefactor As well as the password system the locations of the terminals are used to limit access to the system For instance a nurse can only sign on at the ward to which she is assigned

An ethical committee which includes consultants general practitioners, nurses and lay members lays down rules as to who can be regarded as users and what areas and data users are allowed to access It is not surprising that this project has passed the very stringent tests laid down by the British Medical Association on patient confidentiality ■

- Acknowledgements

Many thanks to Jack Sparrow director of the Exeter project and Hugh Fisher chief systems analyst for the friendly and helpful way in which they provided the information on which this article is based

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David Menzies

Structured Programming

Three professional gentlemen — a surgeon, a civil engineer and a computer system designer — met one evening in a bar and set about discussing the relative merits and origins of their callings.

The surgeon cited the Garden of Eden, claiming that the creation of Eve was the earliest recorded instance of transplant surgery and hence that this was the oldest profession. The civil engineer thought about this, and in his turn recalled the division of water from land and the creation of the firmament, claiming that this was the earliest civil engineering project and demonstrated the pre-eminence of his profession. This left the computer man in something of a quandary, because electronic computers were not invented until the 20th century. Then it came to him. He pointed out that, on the first day of creation, all was chaos and that the Lord created order out of chaos and that that process involved setting about designing a system – the universe – and hence that system design was the oldest profession.

Structured Programming is conceptually a way of designing and building computer systems and, while the claim that its origins lie in the original Creation is a little far-fetched, it is certainly true that the basic concepts and ideas may be traced back to techniques developed in other areas.

An architect who sets out to design a dwelling house will start by enquiring *how many* rooms are required, what each will be *used for*, what *size* each should be and what sort of *amenities* are required (number of power points, lighting, water, gas, windows, cupboards, heating and so on). He then sets about producing a design which contains a number of *elements* (rooms), which shows how the rooms will *fit together*, indicates the *function* of each room and the *additional amenities*, and so on. The end result, by some magic known only to architects, is a structure of some beauty and can be recognised (usually) as being the house which his client wants to live in, with all modern conveniences.

```
(1)   A = B
(2)   Come-From 7
(3)   A = B²
(4)   D = 5
(5)   Come-From 1
(6)   C = A + 3
(7)   B = 27
(8)   Come-From 4
(9)   Stop
```

Figure 1 The COME FROM Instruction

> *'The end result, by some magic known only to architects, is a structure of some beauty'*

How does the architect do this, and how does it relate to computer system design?

Houses, and computer systems, are complex structures which are difficult for the ordinary mortal to understand. When the computer designer appreciates this and that *he* is an ordinary mortal, he looks for some way around the problem – a method of reducing the complexity to a level which he can understand and, having reduced and simplified the problem, he can then set about solving it. Some fifteen or so years ago, a number of wise men in the computer industry devised approaches to better computer systems along these lines. We called the general approach Modular Programming in those days, and the pioneers and their successors have developed and formalised the ideas into what we call **Structured Programming** today. The fundamental thought was that computer programs, like houses, are too big and too complex to understand, so a method had to be found which would allow them to be split into smaller, more manageable units, each of which was small enough to be more readily understood. There are three requirements for such a method to be practical.

- a **set of rules** which define how the decomposition is to be achieved – the shape of rooms and walls in a house
- a **definition** of how the separate pieces of the decomposed system will fit together – the doors, serving hatches, corridors and staircases which the architect incorporates
- a **definition** of the separate pieces *themselves* which satisfies the criterion of being understandable – what is a room?

In brief, the method must be workable, it must produce pieces which can be fitted together like a jigsaw to make the complete picture, and the pieces themselves must be easier to work with than the whole (otherwise nothing has been achieved).

Before proceeding further, let us consider briefly how we humans set about trying to understand something. We find a word in a text which we do not understand – 'Computer', for example, so we look up the dictionary which tells us 'Calculation, reckoning, estimate'.

Not very useful – it was an old dictionary. The definition doesn't take us very far, so perhaps we turn next to Encyclopaedia Britannica and find an article on the subject, which stretches to some 15 pages and gives us a detailed account of the history, component parts, connections, method of working and so on, and refers us to a number of other articles on associated subjects. To find out about computers we don't read old fashioned dictionaries, nor do we set about reading the whole body of English literature, rather, we use a *searching technique* which will pick the pages which interest us, and we then read through sentences and paragraphs in sequence. As we go we repeat the reading of those paragraphs which are not immediately clear and refer to an associated article from time to time to clarify the meaning of a technical term. The human mind is happy to cope with

- **sequences** of words which make up meaningful sentences
- **iterations** or **repetitions** of portions of text to clarify the meaning
- **selections** of those sections which are interesting, coupled with skipping past or non-selection of the text which is not interesting

What we don't do in reading is try to read 3 words from one page, jump on 6 pages and pick out 6 words, back 5 pages ... We don't like jumping around – we do like and understand large easy to read sections of interesting text.

This leads us to the first (and often misunderstood) rule of Structured Programming – avoid the "GO TO" statement. It simply means don't jump around the computer program because computers are sequential machines just as man is a sequential animal; the computer programmer cannot understand a program where the logic jumps around all over the place, and if he writes it that way, he will get it wrong.

Some years ago, the point was brought home to the computer profession by the code in **Figure 1**. (I cannot give due credit to the original author because his name has been lost over the years I can give him my thanks for a beautiful example) He started from the premise that the GO TO instruction should be banned and invented the COME FROM instruction instead – the instruction COME FROM 4 would be executed immediately after instruction 4 – and there followed a series of very serious (?) letters to the editor of the publication concerned extolling the virtue of the COME FROM instruction

Do you understand the code in Figure 1? I won't be surprised if you don't – even experienced computer programmers have to look very very carefully to discern its meaning! The whole thing was invented to show how incomprehensible text was if the flow leapt from place to place, backwards and forwards, and to drive home the lesson that, to be comprehensible, computer systems had to be based upon the sequential, iterative and selective concepts which our minds work upon

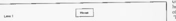

Fig. 2a Top Level Abstraction

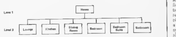

Fig 2b Two Levels of Abstraction

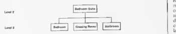

Fig 2c Bedroom Suite

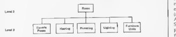

Fig 2d Design of a Room

Figure 2

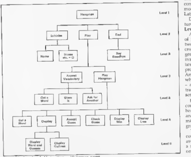

Figure 3 Levels of Abstraction Hangman game

Dijkstra and Jackson

One of the earliest pioneers in this field was **Edsgar Dijkstra** – he decided that there had to be better ways of producing computer systems than those commonly used (and abused) in the 1960's and from his thoughts developed the specification of the **Algol** language and the concept of 'Levels of Abstraction

It has taken many years for Algol to achieve a measure of recognition in the field of computer systems implementation largely because Algol could not be adapted easily to the processing of files of data which is so common in meeting a company's requirements, while other systems (Cobol) were immediately available and relatively easy to use for that sort of application What Algol represents is a language which imposes precisely the rules of **sequence iteration** and **selection** on the system implementation thus making it easy to produce a good, well designed and Structured Program (because the structure is already there in the language) Cobol and other older computer languages may also be used in the same way but the user must impose the rules upon himself and will often find it easy and convenient to break the rules (and suffer for it later) The strength of Algol and its usefulness in implementing Structured Programming concepts and producing good programs has now been recognised and is manifest in the vast variety of different languages (PASCAL ALGOL 68 RTL 2 CORAL DCALGOL, S3, ADA etc) which are now in everyday use and owe their origins to Algol and its concepts – it is a little like the growth of modern European languages from the Latin ancestor

Dijkstra's second contribution to Structured Programming was the concept of **Levels of Abstraction**

Algol and its derivatives provides a set of rules which define the interfaces between pieces and, to some extent the pieces themselves and these rules may be generalised and applied to any computer system and language Levels of Abstraction gives a simple method of breaking a problem down into manageable portions An architect starts with the definition of what he wants to do – Design a House – and this is the highest "Level of Abstraction" of his task and may be represented as in **Figure 2a**

He then considers what the house will consist of – lounge, kitchen dining room bedrooms, bathrooms bedroom suites and so on – his next level of abstraction may be represented by extending the diagram (**Figure** 2b)

The Bedroom Suite of course, may consist of several rooms (**Figure** 2c) and associated with any room there may be a number of aspects (**Figure** 2d) and so on

But notice what happened in this design process suddenly, instead of continuing to design the whole house, the architect has concentrated his attention on one gross unit and is setting about expanding that unit and *only* that unit to the next level of abstraction. In other words, as the design process continues the designer is able to concentrate his attention on finer and finer details and can ignore the complexity of the whole structure – he does not need to know that the master bedroom has a bathroom suite when he is designing the second or third bedroom.

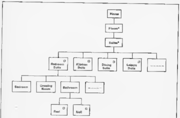

Figure 4 Data Structure Design of a House

The levels of abstraction approach is applied in exactly this way to the design of computer programs. **Figure 3** shows the design of a program which will play Hangman on a micro computer – the highest level of abstraction is the program itself, the second level has three parts (*begin* processing, *play* the game and *good bye*) and so on.

Try the technique for yourself and "design" your journey from home to work: a design, even of a complicated computer program, can be produced in a few hours.

However all this may seem to be rather abstract and difficult to relate to computer systems and the problem of printing bills – and avoiding that hoary old chestnut, the final demand for settlement of an account of £0·00p.

Michael Jackson was thoroughly aware of Dijkstra's concepts and methods but felt that they were not always easy to apply to processing problems and did not always produce consistent results. He developed a method of programming now bearing his name (the Jackson Method or Data Structured Design, explained in his book *Principles of Program Design*) which started from the idea that computer systems had to process data and produce information and data could always be represented as ● a sequence ● an iteration ● a selection of individual entities.

Thus if we consider a typical detached villa, it may be considered as

- an iteration of *floors* (ground floor first floor second floor)
- each floor consists of an iteration of *suites* (i.e. any number from zero to n suites)
- each suite may be any one of a selection of suite *types* (for example bedroom suite)
- each suite type will consist of a *sequence* of one or more *rooms* which are appropriate to that suite type.

This is to be represented diagramatically in **Figure 4**.

Superficially, this looks rather like the diagram which arose from the levels of abstraction approach – it is a hierarchical diagram and a piece of the hierarchy may be examined in isolation from the whole. However, this diagram is a **data structure** diagram which represents the data to be processed, and must be distinguished from the **program design** which it is used to generate.

Jackson's Data Structure Design method involves examining the data to be processed *and* the data outputs which are required from the system and producing data structure diagrams for both. The program design is then derived by merging these structures.

Let's be technical for a moment – consider an input data set which consists of batches of time cards for employees sorted into employee order within department and with batch check totals by department and a program which is to print one wage slip for each employee by departments with a cash cost total for each department. The *structure diagrams* for the input and output data (**Figure 5**) look very similar, but there are some subtle differences. The dotted lines link the corresponding elements (that is, those elements in the input which correspond in a one-to-one sense between the input and the output structure).

The *design* of the program involves producing a third diagram with one box for each corresponding entity and one other box for every other entity (Figure 6).

Separate elements have been included for the batch checking of the input data and for the production of cash totals because these are different functions. Again, we have derived a structure diagram (hence "Structured Programming") and for this example it all looks very simple. If however you produce the diagrams for the case where the input time cards are in batches for each department within each day of the week but the output is again a wage slip for each employee (**Figure 7**), the input and output structures do not match. This is a "structure clash", and several chapters of Jackson's book are devoted to solutions of the problems which arise. Data Structure Design will produce a good design in such cases, but don't imagine that it is always as easy as the first example: it is, however, certainly as hard to solve the same problem in other ways and the end result is usually less satisfactory.

Jackson's approach, then, produces a structure diagram which is similar to Dijkstra's Level of Abstraction but which is based upon the data to be processed *instead of* the functions to be performed. He also includes at the design level in his structure diagrams the concepts of sequence, iterations and selection.

So far, only the design of programs has been discussed. Structured Programming

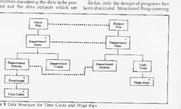

Figure 5 Data Structure for Time Cards and Wage slips

techniques lay great stress on the need to get the design of a program right before starting to build it – would you wish a builder to start erecting your house before the architect s design was complete? This actually used to be an approach to computer programming and is where the legends of bad system behaviour originate There remains the problem of what to do once the design is complete – how does the computer programmer take his conceptual design of a structured program and, metaphorically, translate that into the bricks and mortar of a program which is coded so that the computer will understand it?

We start again with the basic problem that computer systems are complex and too difficult for the human mind to comprehend Structured Design methods have reduced the problem to a hierarchical array of boxes The diagrams do two things for the programmer:

- they break the problam down into a set of boxes, each of which the programmer may consider in isolation from the rest of the system – he can put an ice pack on his head and concentrate on the problem represented by one of the boxes ignoring all the rest
- they tell the progeammer how the boxes *relate* to each other and how they fit together in a logical manner to make up the program

Let's consider these aspects in turn

The lowest level box in Figure 6 is the Time Cards processing box Operations which are involved in processing a card are

- *Checking* aspects of the validity of the card
- *Finding* the time interval between start and end time
- *Adding* time to a total for the employee
- *Reading* the next card

Translating that narrative into programming language for the computer is a simple task compared with writing the whole program – effectively this process is repeated 7 times, once for each box in the diagram, and the program is complete

Linkages between the boxes arise as the functions are specified – one of the functions of processing Employee Wage Slips is processing the Time Cards until the employee identity changes or the file ends which naturally requires a link to the next lower level in the structure Structure Design diagrams for programmers specify the linkages A line from a higher box to a lower box indicates that one of the functions required by the higher box is specified in more detail in the lower box There is also a left-to-right sequence conversion in the structured diagram – the processing of Department Details takes place before the checking of Department Time Totals and that takes place before the Cash Totals are printed for the Department To the experienced user a structured program design will contain nearly as much information as a detailed flow chart of the same program and is often more effective in conveying that information because of its simplicity and brevity

The great strength of the method lies in the relative simplicity of the programs which emerge The human mind is happy to cope with sequences, iterations and selections but is not happy to skip randomly through a large text and structured design reduces programs into a number of boxes or modules each of which can be conceived and implemented in isolation from all the other boxes When these are finally implemented, each box becomes a sequence of lines of code for the computer – something which can be printed on a page and read When the programmer wishes to check his coding, or change it to meet some new requirement he simply uses the structure diagram to pick the right page and *then works on that page alone* until he has it right

Edsgar Dijkstra specified the Algol language as a vehicle for translating his program designs into instructions for the computer Jackson took a slightly different route He specified a meta language (Symbolic Logic) which is not unlike Algol The meta language may be used as a design/coding aid – the programmer is preparing a first draft of the program which he may check as he creates it and double check when he transforms it into a conventional computer language Jackson has developed a translator or preprocessor which will carry out some checks on the accuracy of the Symbolic Logic and will transform it directly into a Cobol program

Structured Programming is a systematic approach to the problem of making computers do what is required – it is an approach which transforms programming from an art form to an engineering science The designer breaks his problem down to smaller and smaller parts and then when the pieces are small enough, he can solve all the little problems and fit them together into the whole Two methods of decomposition have been discussed briefly

- Dijkstra's *Levels of Abstraction* which produces a functional decomposition
- Jackson s *Data Structure Design* which bases the structure of the program on the data which is to be processed

Both methods produce a hierarchical program structure with blocks which can be coded and fitted together to produce a successful program

In a short article it is only possible to give the barest outline of the methods many of the subtleties of the programming methods and a number of topics associated with deeper aspects of Structured Programming have been ignored The interested reader should delve more deeply in the books and papers listed below ■

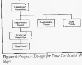

Figure 6 *Program Design for Time Cards and Wage Slips*

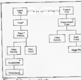

Figure 7 Structure Clash

- *David Menzies FBCS is a Director of John Hoskyns & Company Limited the computer service company He has worked with a variety of computers since the mid 1960 s on a large number of projects and in roles ranging from Programmer through to Project Director He was responsible for the supervision of the development of Hoskyns Education Division s Structured Programming Course Material in this article is drawn from his wide experience of computing and from some of the sessions on that course*

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2 Principles of Program Design	M Jackson	£9 00
3 Elements of Programming Style	Kernighan & Plaugher	£5 00
4. High Level Cobol	G Weinberg (& Others)	£13 00
5 Mythical Man Month	F Brooks	£5 00
6 Implications of using Modular Programming (Central Computing Agency Guide Number 1 published HMSO)		£3 00
7 Program Tuning and Optimisation (C.C.A Guide 4)		£3 00
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CREATING FIGURES

John Lansdown is an architect who has been using computers in his work since the early 60s. He has been Secretary of the Computer Arts Society since its inception in 1968.

Lansdown is Chairman of System Simulation Limited, the firm responsible for the computer graphics for the films ALIEN, SATURN III and a large number of advertisements.

He writes and lectures widely on the subject of computer graphics and was recently awarded a Fellowship by the Royal Institute of British Architects for a study on the impact of Expert Systems on the Construction Industry.

This is the first in a series of articles in which I aim to introduce readers to some of the methods and techniques of computer graphics. Two factors qualify me to do this. Firstly, for almost twenty years now I have been using computers in the context of architecture, art and design. Secondly, as Secretary of the Computer Arts Society, I am lucky enough to be in touch with many of the world's leading computer graphics experts who often let me have details of their latest thinking and techniques together with copies of in-house reports and conference papers. So in this series I hope to bring together some of this information which is difficult for the non-professional computer user to obtain.

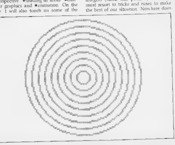
Judging by the number of letters I receive on the subject as well as the questions put to me at lectures, the computer topic that interests most people is how to use their machines to draw pictures. I hope to help in this task, pointing out some of the pitfalls and problems as well as the pleasures and profit in the activity.

Although I do not promise that you will be able to create on your personal computer some of the pictures that are now possible (many of which are indistinguishable from photographs of real objects), points I expect to cover include •perspective •shading in areas •character graphics and •animation. On the way I will also touch on some of the personalities in the business. I will try to illustrate the algorithms and methods in programs which are as machine independent as I can make them but, so that I can be sure they work, the programs I show will generally be in Apple II BASIC. I will also try to answer questions of general interest.

The Fundamental Problem

Apart from questions of mathematics, one of the main reasons that computer graphics is not as easy a subject as it might be is that the computer screens most of us use are based on TV technology. Whilst this has the considerable advantage of cheapness, problems arise because not all the theoretically possible points on the screen are available to us. For economy in storage and electronics those who make personal computers have decreed that, even in so-called 'high resolution' only as few as 300 x 200 points (or maybe 500 x 350 if we're lucky) are usable. Unfortunately this is very much less than we need to enable us to draw with the same sort of precision that we're used to seeing with drawings on paper – where there is effectively no restriction on the number of points we can resolve.

In order to match this with our TV screens, we would need about 4000 x 3000 points, which is far beyond the available technology. Thus in order to live in this graphics world where only integers (small and positive) exist we must resort to tricks and ruses to make the best of our situation. Nowhere does the need for this exist more than in the drawing of circles.



Squaring the Circle

It was said of Michelangelo that he could draw perfect freehand circles; we lesser mortals, however, must make do with mechanical aids and when we use computers to assist us, we need to tackle one or two special problems – even if we have very high resolution screens or plotters.

Consulting a mathematics textbook, we see that the formulae for points on a circle of radius R and centre at 0,0 are
X=R*COS (A) and Y=R*SIN(A)
where the angle A goes from 0 to 360 degrees.

When the centre is at XO, YO these formulae become
X=XO+R*COS(A) and Y=YO*SIN(A)

Now for these formulae to represent the sort of circle we can draw with a pair of compasses, A must vary infinitesimally from angle to angle and, if we tried to program for this, our computer would run forever. Fortunately though the eye can be fooled into thinking it's seeing a circle when in fact it's seeing a many-sided polygon. How many sides needed for this to happen depends on the radius of the circle, but generally not more than about 72 are sufficient, and often very much less.

Thus we can write a program like **Program 1** to embody these formulae. On a high resolution screen or on a plotter, this program gives a good approximation of a circle but, on a TV screen, it looks decidedly ragged even for very high values of N. However, it is fairly fast even though it has to compute sine and cosine for every side. It also can draw polygons of a small number of sides – diamonds, pentagons, hexagons and so on.

We can improve the speed of circle drawing (but, regrettably, not the resolution) by one of our ruses. Again consulting our textbook, we find the following formulae for the sum of angles
COS(A+DA)=COS(A)*COS(DA)–SIN(A)*SIN(DA)
SIN(A+DA)=SIN(A)*COS(DA)+COS(A)*SIN(DA)

By using these formulae we can remove the necessity for the continued recalculation of the trigonometric functions. To do this we make use of a **recursive*** relationship where the values of X and Y at *one* point are used to compute the values at the *adjoining* point. The equations to achieve this are
X(I)=XO+R*COS(A)
Y(I)=YO+R*SIN(A)
X(I+1)=XO+R*COS(A+DA)
Y(I+1)=YO+R*SIN(A+DA)

After some manipulation and use of the sum of angles formulae, we arrive at
X(I+1)=XO+(X(I)–XO)*COS(DA)–(Y(I)–YO)*SIN(DA)

---

* *See Douglas Hofstadter's article, Issue 14*

Y(I+1)=YO+(X(I)−XO)*SIN(DA)+(Y(I)−YO)*COS(DA)

Starting the circle with angle A=0, we have

X(O)=XO+R and Y(O)=0

Then as angle DA is constant, we can calculate the trigonometric functions just once and use the results throughout the run.

Program 2 shows one of the ways that this can be done. In this case, I have not used arrays to hold the values but have plotted them as soon as they are computed. This is a satisfactory idea if only one or two circles are to be plotted on one drawing, but if many circles are needed on each run, then the coordinates of a circle of radius R=1 centred at point 0 0 should be computed at the start and stored in two arrays – one for X and one for Y. As circles are required it is then an easy matter to read off the values, multiply them by the appropriate radius, and add the coordinates of the centre. Thus

X(I)*40+100 and Y(I)*40+50

gives the Ith point on a circle of radius R=40 centred at point (100 50). You should note that this method has an added bonus by using different radii for the X and Y coordinates we can create vertical or horizontal ellipses. Thus

X(I)*40+50 and Y(I)*30+60

gives the Ith point on an ellipse of semi-major axis=40 semi-minor axis=30, centred on point (50.80)

Program 2 should plot circles about twice as quickly as Program 1, but using trigonometric functions at all means we are not trying to live in the integer world of our computer screen. However researchers using ideas derived from methods similar to those in Program 2, have come up with a number of algorithms which can make passable circles consisting only of integer points. One such method is shown in **Program 3**. It derives from the work of a Polish computer scientist Professor Doras and whilst not the fastest of the possible methods is fairly easy to program in a variety of machines. **Fig 1** gives an indication of how the circles should appear.

Next time we look at a way of drawing discs, that is, shaded in circles, and the drawings that can be created with them. ■

```
1  REM --PROGRAM 1
2  REM --CIRCLE OF RADIUS R,
3  REM --CENTRED AT X0,Y0
100  REM --INITIAL DATA
110 X0 = 140:Y0 = 80:R = 50
120 F = 0.017453
130 N = 72
140  HGR
150  HCOLOR= 3
200  GOSUB 1000
999  END
1000  REM --CIRCLE
1010 S = 360 / N
1020  FOR A = 0 TO 360 STEP S
1030 X = X0 + R *  COS (A * F)
1040 Y = Y0 + R *  SIN (A * F)
1050  IF A < > 0 THEN 1070
1060  GOSUB 2000
1065  GOTO 1080
1070  GOSUB 2100
1080  NEXT A
1090  RETURN
2000  REM --MOVE TO POINT X,Y
2010  HPLOT X,Y
2020  RETURN
2100  REM --DRAW TO POINT X,Y
2110  HPLOT  TO X,Y
2120  RETURN
```

Program 1

```
1  REM --PROGRAM 2
2  REM --CIRCLE OF RADIUS R,
3  REM --CENTERED AT X0,Y0
100  REM --INITIAL DATA
110 X0 = 140:Y0 = 80:R = 50
120 F = 0.0174353
130 N = 72
140  HGR
150  HCOLOR= 3
200  GOSUB 1000
999  END
1000  REM --CIRCLE
1010 P = 360 / N
1012 C =  COS (P * F)
1014 S =  SIN (P * F)
1016 X1 = X0 + R:Y1 = Y0
1020  FOR I = 1 TO N + 1
1030 X9 = X1 - X0
1035 Y9 = Y1 - Y0
1040 X = X0 + X9 * C - Y9 * S
1045 Y = Y0 + X9 * S + Y9 * C
1050  IF I < > 1 THEN 1070
1060  GOSUB 2000
1065  GOTO 1075
1070  GOSUB 2100
1075 X1 = X:Y1 = Y
1080  NEXT I
1090  RETURN
2000  REM --MOVE TO POINT X,Y
2010  HPLOT X,Y
2020  RETURN
2100  REM --DRAW TO POINT X,Y
2110  HPLOT  TO X,Y
2120  RETURN
```

Program 2

```
1  REM --PROGRAM 3
2  REM --CIRCLE TEST
100 X0 = 140
110 Y0 = 80
130  HGR
140  HCOLOR= 3
150  FOR R = 45 TO 5 STEP  - 5
160  GOSUB 1000
170  NEXT R
999  END
1000  REM --CIRCLE
1010  REM --DORAS' METHOD
1020 X = R
1030 Y = 0
1040 S = R
1050  FOR O = 1 TO 8
1060  IF O = 1 OR O = 3 OR O = 5 OR O = 7 THEN 1160
1070 S = S + 2 * X
1080  IF Y < 0 THEN 1250
1090 S = S - 2 * Y + 1
1100 Y = Y - 1
1110  IF S > = 0 THEN 1140
1120 S = S + 2 * X + 2
1130 X = X + 1
1140  IF X < > Y THEN  GOSUB 1270
1150  GOTO 1080
1160 S = S - 2 * X
1170  IF Y > X THEN 1250
1180  GOSUB 1270
1190 S = S + 2 * Y + 1
1200 Y = Y + 1
1210  IF S < 0 THEN 1170
1220 S = S - 2 * X + 2
1230 X = X - 1
1240  GOTO 1170
1250  NEXT O
1260  RETURN
1270  REM --PLOT
1280  ON O GOTO 1290,1310,1330,1350,1370,1390,1410,1430
1290  HPLOT X0 + X,Y0 + Y
1300  RETURN
1310  HPLOT X0 + Y,Y0 + X
1320  RETURN
1330  HPLOT X0 - Y,Y0 + X
1340  RETURN
1350  HPLOT X0 - X,Y0 + Y
1360  RETURN
1370  HPLOT X0 - X,Y0 - Y
1380  RETURN
1390  HPLOT X0 - Y,Y0 - X
1400  RETURN
1410  HPLOT X0 + Y,Y0 - X
1420  RETURN
1430  HPLOT X0 + X,Y0 - Y
1440  RETURN
```

Program 3

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COMPUTERS FOR CHILDREN

At the LOGO group in the Artificial Intelligence Laboratory at the Massachusetts Institute of Technology, Papert and his colleagues have created learning environments in which children are communicating with computers in a natural and easy way *Mindstorms* shows how the fundamental concepts of mathematics can be understood and mastered by young children through the use of the techniques outlined here in detail Papert describes how the system works, how children learn and progress in exciting and mind-boggling leaps and relates the experience to cognitive development—especially to the theories of Piaget Papert takes a hard look at the way in which mathematics is taught, and shows in a brilliant synthesis of mathematics and cognitive theory, how math phobia is created in our classrooms and can be overcome with the help of computers This extract from *Mindstorms* is from its introduction, which has been edited for reasons of space

There is a world of difference between what computers can do and what society will choose to do with them Society has many ways to resist fundamental and threatening change Thus *Mindstorms* is about facing choices that are ultimately political It looks at some of the forces of change and of reaction to those forces that are called into play as the computer presence begins to enter the politically charged world of education

Much of *Mindstorms* is devoted to building up images of the role of the computer very different from current stereotypes All of us, professionals as well as laymen must consciously break the habits we bring to thinking about the computer Computation is in its infancy It is hard to think about computers of the future without projecting onto them the properties and the limitations of those we think we know today And nowhere is this more true than in imagining how computers can enter the world of education. It is not true to say that the image of a child s relationship with a computer I shall develop here goes far beyond what is common in today s schools My image does not go beyond it goes in the opposite direction

In many schools today, the phrase computer aided instruction ' means making the computer teach the child One might say the *computer is being used to program* the child In my vision *the child programs the computer* and, in doing so, both acquires a sense of mastery over a piece of the most modern and powerful technology and establishes an intimate contact with some of the deepest ideas from science, from mathematics and from the art of intellectual model building

Programming a computer means nothing more or less than communicating to it in a language that it and the human user can both ' understand And learning languages is one of the things children do best Every normal child learns to talk Why then should a child not learn to ' talk' to a computer?

There are many reasons why someone might expect it to be difficult For example, although babies learn to speak their native language with spectacular ease most children have great difficulty learning foreign languages in schools and, indeed, often learn the written version of their own language none too successfully Isn't learning a computer language more like the difficult process of learning a foreign written language than the easy one of learning to speak one's own language? And isn t the problem further compounded by all the difficulties most people encounter learning mathematics?

Two fundamental ideas run through this book. The first is that it is possible to design computers so that learning to communicate with them can be a natural process more like learning French by living in France than like trying to learn it through the unnatural process of American foreign language instruction in classrooms Second learning to communicate with a computer may change the way other learning takes place The computer can be a mathematics-speaking and an alphabetic-speaking entity We are learning how to make computers with which children love to communicate When this communication occurs children learn mathematics as a living language Moreover mathematical communication and alphabetic communication are thereby both transformed from the alien and therefore difficult things they are for most children into natural and therefore easy ones The idea of talking mathematics to a computer can be generalized to a view of learning mathematics in Mathland" that is to say in a context which is to learning mathematics what living in France is to learning French

We shall see again and again that the consequences of mathophobia go far beyond obstructing the learning of mathematics and science They interact with other endemic "cultural toxins" for example with popular theories of aptitudes, to contaminate people s images of themselves as learners Difficulty with school math is often the first step of an invasive intellectual process that leads us all to define ourselves as bundles of aptitudes and ineptitudes, as being mathematical or "not mathematical" 'artistic' or "not artistic' "musical ' or

continued on page 50 ▶

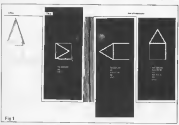
Fig 1

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Now You See It-Now You Don't

Worried about the security of your software? Don't waste your energy

Reading is usually one of the less thankless tasks to fall the way of the professional scribe. Apparently endless streams of erudition present themselves in competition across the humble journalist's desk, each clamouring to be perused, examined and analysed for that obscure gem of information that leads to the one thing we all seek – A GOOD STORY

Much of that reading material is quickly discarded as being not worth the paper it is written on, and it is not often that a mistake is made in this area of snap value judgements. But every so often a little gem can and does shine through, bringing light to the day, and even a little envy mixed in with the respect held for the writer.

Now, it so happens that such a gem came to light the other day in the offices of *Computerworld UK*. Twas not even me that first saw the document in question, it being drawn to my attention by a colleague who said, in the bright clear diction of the eagle-eyed, "Here, read this." So I did.

The document was Sigplan Notices of December 1980, a regular publication put out by the Association for Computing Machinery in the United States of America. Sigplan Notices is a collection of informal discussion papers on matters of moment in the computer community and industry, and as such can normally be considered as a weighty tome – to be read only to find out long-term industry and user views on what is happening in the mainstream of the computer business, with perhaps a little about new techniques and things like that thrown in. I have to admit that the publication has never been amongst my top ten all time hits.

However, the December issue managed to publish just one article that not only caught my eye and took my fancy, it seemed to say so much about the problems of the computer industry – and in particular the overall standards of programs and programming within the industry – that I feel its essence should be shouted long, loud and interminably. This I intend to do right now – loudly. Though, within the confines of this article, not interminably.

The article in question is entitled "Protection of Proprietary Software", written by one Nora M Taylor, of 5216 Westpath Way, Bethesda, Md, in the USA. At first this may not seem to be a stunningly inviting title, and, in truth, the article only came to light because it is a subject that interests the aforementioned colleague. However, the words that Nora Taylor has set down somehow seem to say a great deal about the way that computers — all computers – are programmed, and about the way that the programming task is organised.

Basically, what she says is that the programming function and its organisation is still a pig's ear, no matter what wondrous developments the hardware technologists come up with. Something tells me she is right.

The basic tenet of her article is simple. It is that the majority of programs written need no special attention to the question of protection or security because they are so badly written, so poorly documented and are so totally alien to everyone else in the world other than the original programmer that there is no actual need for such care.

But not for her the use of the serious dissertation to put across her point. What makes it all so interesting is the splendidly acerbic tongue-in-cheek she carries through the piece.

Certainly she starts seriously enough with the suggestion that she is about to disclose a highly successful technique for protecting proprietary software, and indeed that is what she does. As she points out, it is both simple to implement and extremely effective in operation, once learned and mastered. Mastery of the technique is also simple, as it is extremely obvious. Most programmers and programming teams perform the technique quite naturally, though they may not know it.

The basis of the approach is to develop the concept of "trade secrets" to a more formalised logical conclusion. In essence *nobody should know anything about anything*. Simple really, and it works. In many organisations it has worked impeccably for many, many years.

Here are some examples of what she says on the technique. "There is no review of program design by anyone other than the programmer and the customer – no walk through, no desk checks. Each programmer keypunches or types his/her own programs." Well, maybe that sounds OK so far, especially when related to the type of programming that is done on, and for, microcomputer systems, but her story gets better or worse.

Take for example an important part in the development of both good programs and good programmers – training and the knowledge and use of standards. (Both of these are believed to have at least a small relevance to microcomputing.)

"Programming instruction for new (recruits) is minimal, and advance classes are virtually non-existent. This ensures that the programmers' styles and methods quickly diverge. ... No software or programming standards are prescribed. ANSI Cobol and Fortran are available but there is no rule against using non-standard extensions to the language."

Are you beginning to get the feel of it? Try another one.

"Programmers are not supplied with the latest updated manuals, ostensibly to save money, but actually to further discourage any collusion (sometimes called consultation) among them. Each programmer has whatever edition of the manual we had on hand at the time he started work." This section is sweetly terminated with a gentle barb: "The computer vendors have co-operated nicely on this by frequently changing the versions, publication numbers and pagination of their manuals."

As Nora Taylor points out, this has the planned effect of stopping all programmer consultation.

How about documentation, another essential tool if someone else other than the original programmer wants to know what the hell is happening? Here is what Nora writes about that subject: "Documentation is non-existent, poor, or at least late so that it is of little use in learning what a program does. If possible, programs are not documented separately from the research project to which they are related."

I hope this is beginning to ring just a few bells somewhere with someone. As a software protection technique it appears to have all the right attributes. As an everyday event it seems horribly familiar. But I digress, Nora hasn't finished yet.

"Program documentation, if any, may be edited by a technical writer, but is not reviewed by anyone who would understand it." Oh, how true, how true.

Here is yet another one of Nora's gems. This time she addresses the subject of program testing. "Programs are tested only for their immediate known uses, so that if they are used with only slightly different data they probably will not work. Furthermore, they are tested only by their author, possibly in consultation with the customer, but certainly with no one else."

Nora Taylor has outlined what must be the simplest and most effective form of software protection ever invented. The one problem is of course that she hasn't actually invented it, the technique has been in existence for years. With the growth in the use of microcomputer systems, not for fun and entertainment in the home but for real, live, money-earning tasks in business, the bad practices she has outlined need strict attention if micro software is ever going to be good enough. Even if it means that more complex protection techniques have to be adopted instead.

One final point. For those who want to read more of her excellent article, and/or the rest of Sigplan Notices, copies can be obtained from The Association for Computing Machinery, 1133 Avenue of the Americas, New York, New York 10036. ■

Martin Banks is now with **Computerworld UK** *a computing weekly*

BRAND NEWs compiled by Microspy with Anthony Esgate 16

This middle section may either be pulled out or photocopied then filed for reference. It will be comprehensive and range over the whole field of products, services, events and courses. **PU** stands for Personal User. **SB** stands for small base – that is small budget or small business. **MB** – medium base, medium budget or medium business. **BB** – big base, big budget or big business. **Addresses** are to be found at the end of **Brand News.**

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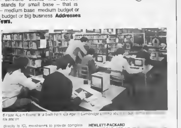

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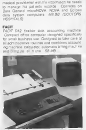


The F[illegible] flexible disc [illegible] machine

HEWLETT-PACKARD
HEWLETT PACKARD HP [illegible] puter designed for test, mea[illegible] ment control applications [illegible] operating system and [illegible] of HP 85 personal computer [illegible] ners problem by making [illegible] tively low cost hardware [illegible] on software development and [illegible] advantage in bringing a completed [illegible] use. £920 *MB(TEST MEASUREMENT INSTRUMENT CONTROL)*

[illegible] computer system

HOWERINE CALVERT LTD
HOWERINE CALVERT LTD computer [illegible] plines to automate their estimating [illegible] Based on Hewlett Packard [illegible] tional computer. Keeps production [illegible] to 10 presses, 10 types of finishing [illegible] 40 ways of costing artwork [illegible] era work. Subcontractors' work [illegible] packaging etc built in. [illegible] *MB(PRINTERS)*

MAGNUSON
MAGNUSON M80/44 computer system [illegible] users with from 1.5 to 1.7 times the performance of the IBM 4341 Group 1 for only 12% more [illegible] and performance equal to the 4341 Group 2 is

£60000 less. Standard configuration of 8 channels and 2 Mbytes memory costs £160000. Supports same operating systems as 4341 2 DOS VSE VS1 MVS.SP and VM. *SB(IBM COMPATIBLE)*

MESSERSCHMITT GmbH
MESSERSCHMITT GmbH intelligent programmable ENTRY CONTROL SYSTEM. Access terminals have own intelligence duplicating that of CPU and operating fully and automatically in event of CPU or data line problem. In standalone mode may be connected to a printer. Readers are user programmable through use of hand-held device. Two stand alone systems and three on line systems are available. Each reader has a 1024 card and 81 time zone capacity. Largest system utilises CRT hard disk and 132 column printer. *MR(SECURITY)*

MML LTD
MML LTD distributor for Digital Microsystems Inc's DSC 4 professional microcomputer. Z80 based 128K RAM. Designed around Intel Multibus standard. Available with twin 8" floppy disks in IBM 3740 or System 34 format or with one floppy replaced with an 8" Winchester Disk system with 10 or 30 Mbytes capacity. Multibus format allows field upgrades from 128K to 512K RAM, Z80 to Intel 8086 CPU, I/O ports in multiples of 8 and special functions such as protocol conversion. Support CP/M operating system. Digital Microsystems network system HiNet fully compatible with CP/M offers RS422 SDLC communications with 500 Kbaud transmission rates and 1000 more cable connections. *MB*

NCR
NCR JAPAN (Japanese Advanced Processing Architecture by NCR) Japanese language processing system. Adds full Japanese language processing capabilities to an existing alphanumeric katakana based system. Will eventually be used for Japanese language applications on all NCR products. First such a I 8290 family of computer systems supporting both conventional and JAPAN software. *MB SB*

PYE BUSINESS COMMUNICATIONS LTD
PYE BUSINESS COMMUNICATIONS LTD (PHILIPS) EBX 8000 computer controlled PABX system capable of expansion from 200 to 8000 extensions. Stored program control (SPC) provides flexibility to accommodate widely differing user requirements. Provides comprehensive monitoring, built in call recording, traffic density recording and facility monitoring. Communications facilities include ring back and follow me. Con[illegible]ssors operating [illegible]

[illegible] high [illegible] document [illegible] and data [illegible] can be interfaced with word p[illegible] computers view data and message switching systems. *SB*

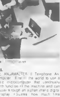
RAPID RECALL
RAPID RECALL new products include INTEL military standard 4K static RAMs, new Intellec development systems, two new Series 80 memory system modules, DEC high performance video board for LSI PDP 11 systems, LSI 11 interface board for IEEE instrument bus and bootstrap PROMs for DEC multi function modules. *MR SB OEM(DEC INTEL)*

RCA
RCA CDP18S604 single-board computer. Con[illegible] p3 [illegible] pans[illegible] [illegible] COSMAC [illegible] *SYSTEMS DESIGNERS OEM*

BRAND NEWs

SINTHOM
SINTHOM has added Hewlett Packard's HP 85 Personal Computer to its range. The HP-85 is an attractively priced desk top computer with capabilities suited to the needs of professional users whether in engineering, science or commerce. *PL SB MB*

SPERRY UNIVAC
SPERRY UNIVAC two new models in V77 minicomputer range: V77 800 and V77 700. 16-bit micro programmable, designed for easy upgrading in the field. Compatible with Sperry Univac commercial and networking software plus DCA Distributed Communications Architecture. Feature high speed CPUs, memory mapping and control, error detection and correction hardware, multiply and divide and direct memory access. Writable Control Store (SCS) 2K 48 bit words in both machines. Up to 2048Kbytes MOS error correcting memory can be installed in 700 (1024 800). Memory cycle time 600 nanoseconds. Optional floating point processors. Vortex II operating system. FORTRAN IV, COBOL, RPG II, micro and macro assemblers. Standard software products include transaction processing, remote job entry, database management, remote batch terminal emulation and telecommunications access. Peripheral devices and I/O interfaces support moving head disk and magnetic tape drives, keyboard CRT display terminals, line and character printers, card readers and punches. General purpose interfaces and relay and analogue digital interfaces. *MB SB OEM*



Sperry Univa[illegible]

STORACALL
STORACALL ANSAMASTER II Telephone Answering Computer. First in the world to use a self diagnostic microcomputer that continually monitors each function of the machine and can talk to the user through an alphanumeric digital display. Display indicates how much time elapsed while recording an announcement, how many calls received, which call being listened to during playback, whether a call is being taken, whether the has misoperated unit or fault is present. Remote recall facility enables user to play back messages without returning to location of unit. Purchase or rental from £3.95 per week. *SB MB*

TANDBERG
TANDBERG TCS450 Educational System based on Brees 3450 minicomputer custom built to provide facilities that educational and other institutions need to run timetabling, administration

Ansamaster II from S[illegible]

and school records [illegible] high capacity floppy disks and [illegible] keyboard. TDOS operating system supports FORTRAN, COBOL and Z85-ASM assembler plus utilities, as well as superBASIC, screen entry and database management. *SB MB(EDUCATIONAL)*

TANDEM
TANDEM new datacommunications capabilities enabling Tandem computers to communicate with IBM and other mainframes. Tandem to IBM link (TIL) is for point-to-point transmission to a single IBM computer whilst Tandem Hyper Link makes Tandem computer accessible to a local network of several dissimilar computers. Remote job entry facilities have also been enhanced by addition of HASP multi leaving workstation capability which allows interleaved jobs and files to be transferred between Tandem and non-Tandem computers. *SB*

TRANSDATA
TRANSDATA Cx 400 family of microcomputers incorporate design features of Cx 400 range but has added potential of multi-language operation. CP/M operating system in multi user version MP/M permits different programs in various languages to be run simultaneously. Based on multiprocessor architecture using Z80A as master processor running at its full 4MHz clock rate. Available with dual 8" floppy disks, 20 Mbyte hard disk system (8" Winchester) and single floppy disk, or 20Mbyte hard disk with [illegible]" cartridge tape for back up and single floppy disk. *MB OEM*

TRIVECTOR
TRIVECTOR TRITON 4 64K processor, 22 Mbytes backing store, security tape, VDU keyboards and reporting printer. Expansion by units to 128 Mbytes backing store, 4 processors (each with memory expansion to 128K), 16 VDUs keyboards and 8 reporting printers. May be used with any general purpose Z80 software, though main support is through CAP MicroCOBOL under the business operating system BOS. For users running under CP/M other compilers include CIS COBOL, Pascal and BASIC. Application packages include Autoindex, AutoClerk, Purchase Ledger, Nominal Ledger, Sales Ledger, Inventory Control and Payroll. *MB*

Triton 4 fr[illegible] T[illegible]to

WANG
WANG WANGWRITER wordprocessing system. Features 12" diagonal CRT unit that shows 24 lines of 80 characters, [illegible] floor standing printer console housing 20 characters per second Wang daisy wheel printer, a dual sided double density mini diskette drive and accompanying electronics. Text editing features include typewriter mode, comprehensive advanced formatting, glossary, 10, 12 and 15 pitch printing and type through mode. In addition Wang has announced a related MINIDISKETTE WORKSTATION peripheral device available on all Wang Office Information Systems (OIS) and providing media compatibility with Wangwriter minidiskette. *MR SB*

Applications

ANGUSGLOW
ANGUSGLOW [illegible] ALPHA [illegible] able [illegible] in Alpha Micro [illegible] Release [illegible] compatible with Data General [illegible] for [illegible] display [illegible] in a [illegible] comparison [illegible] extensions [illegible] most efficient screen handling [illegible] diagnostics. SB MB(ALPHA MICRO)

CELDIS
CELDIS new operating system AMPL [illegible] on Texas Instruments FS 990/4 and FS 990/10 systems. Serves as a major advance [illegible] and faster microprocessor development. Supplied on single 8" floppy disk. *SYSTEMS DESIGNERS PROGRAMMERS*

COMPUTERPLAN
COMPUTERPLAN [illegible] application packages for Data General computer systems: Sales Ledger, Purchase Ledger, Payroll, Finance Reporting, Order Entry, Invoicing, Purchasing, Stock Control, Word Processing, [illegible] Mailing, Subscription Circulation System, Client Accounting, Time Recording, Dateplan. MB 99 *DATA GENERAL*

COMPUTER ROOM
COMPUTER ROOM CHARGEHAND Garage Costing System for 3000 and 4000 Series PETs. Working from External and Internal invoices the system produces [illegible] Daily and Monthly reports on Revenue Centres, Discounts and VAT. Also allows for [illegible] operations. Of particular use in managing departmental budgets, making sales forecasts and returning information to the Garage. [illegible] System is double entry and keeps Brought Forward totals for annual [illegible] £450 plus VAT. SB MB *GARAGE*

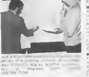
CORTEX COMPUTER SYSTEMS LTD
CORTEX COMPUTER SYSTEMS LTD INTERCOM and SYNC-IMM [illegible] packages for PET [illegible] to include distributed processing. [illegible] interfaces to any asynch [illegible] send and receive files using [illegible] purchase and RS232 [illegible] ASCII [illegible] data [illegible] directly [illegible] provides same [illegible] IBM Honeywell [illegible] Burroughs and NCR machines [illegible] £800 [illegible] processing capabilities of PET [illegible] £1,100 [illegible] MB PET

DIGITAL DEVICES LTD
DIGITAL DEVICES LTD now supply a range of CP/M compatible software by Supersoft Inc including UTILITY PACK, DIAGNOSTICS, ENCODE/DECODE, TERM, SUPER M LIST and FURTH [illegible] MICRUSTAT statistics package for North Star Horizon developed by Ecosoft Inc. is available. Consists of a library of programs that perform most common statistical procedures. *MB(CP/M NORTH STAR)*

ENERTECH LTD
ENERTECH LTD PASCAL 16C. Supports a subset of Pascal with interpreter and pseudo compiler available on cassette. For [illegible] or Z80 microcomputers. Loads and operates in [illegible] RAM requiring min 16kbytes plus memory mapped video display. Occupies approx 13K and includes system bootstrap. MAPP 1.AZ floating point package, MAPP extension and screen editor. Compilation is to compact relocatable MAPP code. £35 PUSB MB *(NASCOM RML)*

FREIGHT COMPUTER SERVICES LTD
FREIGHT COMPUTER SERVICES LTD DIPS Do It Yourself Distribution Planning. Available as package or bureau service. Comprises a range of programs covering accounts clustering [illegible] delivery [illegible] integrated [illegible] *(DISTRIBUTION)*

BRAND NEWs



GEEST COMPUTER SERVICES
GEEST COMPUTER SERVICES [illegible] Ryan Mohd [illegible] and COBOL [illegible] designed [illegible] Texas [illegible] Model 1 and 2 [illegible] devices. *MB OEM TEXAS INSTRUMENTS*

GRAFFCOM
GRAFFCOM ISBS [illegible] Small Business Software for Winchester [illegible] micro computer systems [illegible] Order Processing [illegible] General Accounting, Payroll [illegible] Each module [illegible] Designed for [illegible] MP/M. SB MB

ITT
ITT CNS [illegible] Networking System. Provides a [illegible] network trunking facility for front end processors and [illegible] concentrators in a data communications network. Component of CNA Communications Network Architecture. Designed to operate with 3500 range of programmable communications [illegible] transferred across trunk [illegible] dependent. BB

AM JACQUARD SYSTEMS LTD
AM JACQUARD SYSTEMS LTD [illegible] Paper Tape [illegible] on J100 and 500 [illegible] facilities produce [illegible] systems [illegible] communications [illegible] and exchange [illegible] with a variety of time sharing and other asynchronous devices. MB

LANDSLER SOFTWARE LTD
LANDSLER SOFTWARE LTD HOTEL GB2 Guest Billing System. Contains [illegible] Hotel GB plus new [illegible] including [illegible] catering for Bed & Breakfast [illegible] Found [illegible] available in various [illegible] CP/M PET. *MB(PET) HOTELS*

LINLATHEN COMPUTER SERVICES
LINLATHEN COMPUTER SERVICES [illegible] FPAS [illegible] asset and inflation [illegible] Runs [illegible] RPG II and [illegible] IBM System 34 machines. PRIAC [illegible] provided as a bureau service. From approx £5000. MB

LIVEPORT LTD
LIVEPORT LTD LIVEPORT BUSINESS SYSTEM [illegible] company accounting package developed to meet the requirements of UK accounting and auditing practice. Includes Sales, Purchase and Nominal Ledgers, Stock Control, Wages & Salaries. A 55K machine (minimum) is required to run the suite of programs. MB

LUCIDATA
LUCIDATA P 6800 PASCAL SYSTEM OPERATING VAR [illegible] Motorola [illegible] ETHERNET [illegible] [illegible] 5 or 8 floppy [illegible] SMIX 6800 6809 [illegible] EXORCISOR [illegible] HEATH H8 [illegible] configuration 20K RAM [illegible] floppy disk drive. BB

MICRO FOCUS
MICRO FOCUS [illegible] COBOL [illegible] 8086 segment [illegible] system [illegible] memory [illegible] 8087 [illegible] *SYSTEMS DESIGNERS (CP/M 8086)*

MMD ASSOCIATES LTD
MMD ASSOCIATES LTD program Jacquard Connection developed by AM JACQUARD to enable disks from AMtex word processors to be read by J100 and J500 word and data processors. Floppy-disk based. £70. *MB(AM JACQUARD)*

NCR
NCR PICO program report generator cuts programming time by up to 80% by producing COBOL source programs from parameters specified by user. Available on I 8200 Series. Parameters entered and edited through video terminal [illegible] from a master file and up to 9 subsidiary files can be combined to produce a report. Consists of [illegible] programs: first handles creation, updating and printing of parameter file, second generates COBOL source programs. In addition NCR have released Sales Analysis module of IMCS Interactive Manufacturing and Control System to production and inventory control in small and medium sized manufacturers using NCR 8250, 8270 and 8430 small computers. SB MP BB

NEWBEAR COMPUTING STORE LTD
NEWBEAR COMPUTING STORE LTD WORD PROCESSING package for Sharp MZ80K. Handles files up to 255 lines long but does not [illegible] justify. Has Help, Print, Replace, Give, New, File, List, Insert, Save, Delete and Find [illegible] £18.50 plus VAT. Also available BASIC Extensions for MZ80K. Additional functions: Break, Trace, Single Step, Block Delete, Renumber, Auto Number, String [illegible] Logical operations, Reset, USR(x) and [illegible] cursor control. £12 [illegible] plus VAT. *PU SB MB(MZ 80K)*

PAXTON COMPUTERS
PAXTON COMPUTERS BUSINESS DESK package now offered [illegible] the shelf business and administration system through dealers. Business Desk [illegible] software package offering complete [illegible] business administration facilities including [illegible] stock control, sales ledger, [illegible] ledger, [illegible] ledger, VAT recording and [illegible] Each [illegible] incorporates a [illegible] reporting features. Written in CBASIC [illegible] CP/M. £2400. MB

PERSONAL COMPUTERS LTD
PERSONAL COMPUTERS LTD DESKTOP PLAN [illegible] package [illegible] managers [illegible] budgeting and [illegible] balance [illegible] User programmable [illegible] Menu [illegible] plus VAT [illegible]

STAGE ONE SOFTWARE
STAGE ONE SOFTWARE PETAID database [illegible] available on [illegible] disk based PET [illegible] Sorting [illegible] supported [illegible] label printing [illegible] 64 characters [illegible] SB *(PET)*

PRIME COMPUTER
PRIME COMPUTER TAPS [illegible] system [illegible]

[illegible] interfaces [illegible] manager [illegible] BB

QUINTEX SOFTWARE
QUINTEX SOFTWARE QUINTESS [illegible] PL/1 for use on IBM [illegible] 4300 machines has [illegible] tests. Automatically produ[illegible] versions of unstructured COBOL programs. GOTO statements are automatically removed and replaced by PERFORM and IF THEN ELSE structs. Resulting program [illegible] each with one entry and one exit point. [illegible] are now interested in [illegible] the program to users at [illegible] users return feedback [illegible] *BB (IBM 360 370 3300 4300)*

RAPID RECALL
RAPID RECALL PASCAL-86 88 COMPILER for APX 86 88 Microprocessors (8086 8088). Designed to run on either Intellec Series III Microcomputer Development System or on Series II or Model 800 systems which have been upgraded with the addition of a Model 556 upgrade package (Pascal-86/88 is an extension of standard Pascal). *PROGRAMMERS SYSTEMS DESIGNERS (PASCAL)*

RCA
RCA PRICE computer cost prediction system (Programmed Review of Information for Costing and Evaluation). Comprises a family of three parametric Cost Prediction Models: basic model predicts development and production costs for technical devices or systems while they are still in concept stage; PRICE L, the Life Cycle Cost Model, computes support costs for many varieties of systems and can predict costs over a 30 year field life; PRICE S, the software model, applies the parametric modelling methods to the problems of computer software costing. *BB (COSTING)*

SHERWOOD COMPUTER CENTRE LTD
SHERWOOD COMPUTER CENTRE LTD in conjunction with ICL SPARTACUS. Originally available as a bureau service, now available as a total minicomputer software/hardware package with ICL ME29 computer. SPARTACUS is a real time on line system for the insurance market. *MB BB (INSURANCE COMPANIES UNDERWRITERS BROKERS)*

TRANSDATA
TRANSDATA FASCOS 1 File Access and Storage Communications Operating System: enables users to connect their asynchronous terminals at [illegible] and high speed modem to a data transmission line working at a higher speed than the terminals [illegible] of particular interest to the time sharing user since input may be entered and shown [illegible] £50 per [illegible] *SB MB*

UCL
UCL UK distributors of ULTIMATE computer [illegible] Release 10 [illegible] operating system. Additional capabilities include multiple [illegible] with high speed [illegible] printers and [illegible] printer [illegible] and multiple [illegible] employing output queues [illegible] with [illegible] disk drive [illegible] controller [illegible] tape back up [illegible] information [illegible] and [illegible] and [illegible] improvements including automatic power fail warmstart recovery [illegible] BASIC routine speedup [illegible] BASIC [illegible] an expanded editor [illegible] include multiple [illegible] capabilities and [illegible] security [illegible] access to [illegible] ULTIMATE computer systems employ Honeywell hardware and Ultimate operating system). *MB BB (ULTIMATE)*

WESTINGHOUSE MANAGEMENT SYSTEMS LTD
WESTINGHOUSE MANAGEMENT SYSTEMS LTD [illegible] data management system. Uses simple free form English like statements: easy to use, powerful enough to use as a production language and ideal for report generation. Available [illegible]

BRAND NEWs

[illegible]

Processor & Memory Boards, Chips, Programmers, Test Aids.

ABS COMPUTERS
ABS COMPUTERS MX [illegible] to ease the [illegible] of [illegible] based on the newly launched M[illegible] range of [illegible] computers. Controls remote [illegible] modem link. Transmits at up to 9600 baud. Fully buffered, capable of multiplexing [illegible] up to 4 serial and 1 parallel data [illegible] composite data stream for transmission over synchronous/asynchronous datalink using SDLC protocols and demultiplexing. Based on Intel 8085A microprocessor with up to 12K RAM and 8K ROM, error checking and correction firmware. In addition ABS have made available new memory modules for old BCL Molecular 18 systems. *MB (ABS BCS)*

ASTRALUX
ASTRALUX QUICK CONNECT point to point wiring system for circuit boards: offers significant advantages over wire wrap techniques in prototype wiring applications. Uses insulation displacement connection techniques developed originally for ribbon cable mass terminations. Developed by Bell Laboratories and converted into a commercial system by Robinson Nugent. *ENGINEERS*

BEAULIEU ELECTRONICS LTD
BEAULIEU ELECTRONICS LTD CMOS Add On Memory Boards: 4K, 8K and 16K byte versions compatible with Motorola Exorciser and Rockwell System 65. Low power consumption, access time approx 200ns, on board NiCad battery back up, power fail detection and charging circuitry. *PU SB (EXORCISER SYSTEM 65)*

BLUEBEST
BLUEBEST 16-64 Video Interface Card: enables user to interface a computer to a remote monitor [illegible] RS232 interface. Accepts standard 64 character ASCII code at up to 1.2 kilo baud and can be used full or half duplex. 1Kbyte display memory formatted as 16 lines of 64 characters. With UHF/VHF modulator can be used with standard black/white television set. *PU SB MB)*

T J BRINE ASSOCIATES
T J BRINE ASSOCIATES new Roadrunner Eurocards for microprocessor applications. Can be supplied with Road runner wiring strips already mounted. *MANUFACTURERS*

CELDIS
CELDIS new products include MM74FC138 three-to-eight line decoder/de multiplexer, TM990-189M Learning Aid developed by Texas Instruments, high speed TTL devices identified by the prefix 74F, Series 80 compatible Analogue I/O board with on board memory, 4N55 dual channel Opto-Coupler developed by Hewlett Packard, MOC 3020 optically isolated Triac Driver developed by Motorola, and integrated Circuits for 32 channel Remote Control applications. *OEMs ENGINEERS*

CETRONIC LTD
CETRONIC LTD REGUVOLT range of mains voltage controllers, designed to overcome the serious problems of irregular voltage supply and transient interference often encountered in the operation of computers and allied system. Benefits include transient suppression (gives software and hardware protection), brownout protection (prevents microprocessor and system crashes), isolated secondary [illegible] gives electrical [illegible] between mains and computer), fast voltage regulation and removal of low frequency mains harmonics. Single phase 120VA – 20kVA, 3 phase up to 60kVA. *ENGINEERS*

COMPUTER AUTOMATION
COMPUTER AUTOMATION new BISYNCHRONOUS INTERFACE [illegible] communications controller for interfacing Naked Mini/NM4 computer systems to [illegible] devices that follow standard IBM binary synchronous communications protocol. [illegible] RS232 [illegible] with modems; RS422 [illegible] devices over cable up to 4000ft [illegible] connecting to an I/O [illegible] equipped with [illegible] programme [illegible] over bisync [illegible] transparent modes, synchronization [illegible] and error checking. Also determines [illegible] control and [illegible] length. Max transmission rate 4800 baud. Transmits and receives characters from 5 to 8 bits in length. Performs CRC error checking automatically on all data transmitted or received. Also automatically inserts or strips SYN control characters. *BB*

COMWAY MICROSYSTEMS LTD
COMWAY MICROSYSTEMS LTD Intel SBC 80-10 board: complete computer system on a single PCB based on Intel 8080 CPU. Up to 4Kbytes of RAM, 16K ROM, 48 programmable parallel I/O lines with sockets for interchangeable line drivers and terminators, serial communications interface, single level interrupt with 11 sources, auxiliary powerbus and powerfail interrupt control logic for RAM battery backup, SBX bus connector. *SYSTEM DESIGNERS OEM*

CONTINENTAL SPECIALTIES CORP
CONTINENTAL SPECIALTIES CORP Model 4401 Benchtop Frequency Standard: provides source of discrete, selectable precision frequencies for use as either a time or frequency standard or as a highly accurate signal source. 10 MHz precision crystal oven oscillator, frequency select and frequency multiplier controls. *ENGINEERS*

DATA GENERAL
DATA GENERAL [illegible] new communications products [illegible] microNOVA MP 100, MP 200 and microNOVA Profit Computer (MBC): Asynchronous Synchronous Line Multiplexor (ASLM) Model 4335, [illegible] asynchronous interface Model 4379 AS, and a communications software package MP [illegible] Communications Package (MCP). First has 4 serial communications lines with modem control, each line supporting either [illegible] synchronous protocols or asynchronous communications. High speed operation to 19200 baud is possible in either mode. Lines [illegible] independently programmed [illegible] for [illegible] working applications [illegible] concentrator. Line interface meets EIA RS232C and CCITT V24 specifications. Prices £480, £391, £378 [illegible] licence £65). *BB OEM*

DATA TRANSLATION
DATA TRANSLATION ZIATECH ZT80 self contained intelligent controller for computer peripheral and instrument systems using General Purpose Interface Bus (GPIB IEEE 488). Provides access from any multibus compatible computer to printers, plotters, tape cartridges, floppy disks etc. Able to talk, listen and control. Ideal for OEM systems production testing, lab experiments, microcomputer development, data collection, one shot testing and other applications. *OEMs ENGINEERS*

DIGITAL DEVICES LTD
DIGITAL DEVICES LTD new products include DL[illegible] Analogue Communications Multiplexer developed by [illegible] [illegible] 1200 baud [illegible] RS232 [illegible] *MB*

DIGITAL EQUIPMENT CORP (DEC)
DIGITAL EQUIPMENT CORP (DEC) first [illegible] PACKETNET PROGRAMME PACKETNET SYSTEM INTERFACES FOR TRANSPAC (FRANCE) and DATAPAC (CANADA). PacketNet Programme [illegible] provide X.25 capability [illegible] PDP 11 minicomputers, VAX supermini [illegible] ters and the DECsystem 10 and 20 family [illegible] mainframes. Specific software packages [illegible] of the countries will enable Digital [illegible] and terminals to communicate with each other [illegible] non Digital systems connected to the [illegible] *SB*

EAGLE
EAGLE Models ELP 150 and ELP 200 logic probes designed for fast and reliable testing of input/output logic of digital circuits. Logic level shown by a red or green LED indicating logic1 or logic2. ELP 200 also has pulse stretcher to detect high speed switching and a memory to allow detection of infrequent signals. Switching for TTL or CMOS [illegible] *ENGINEERS*

Model [illegible] probe from Eagle features a pulse stretcher [illegible] memory

FERRANTI
FERRANTI ZN440 ultra high speed 6-bit parallel A/D (Analogue to Digital) converter suited for applications in high speed data acquisition, video and radar conversion, digital signal storing and image processing. Digitises an analogue signal at rates from DC to 18 mega samples per second. AC signals with frequency components up to several MHz can be digitised accurately without the need for an external sample and hold circuit. Packaged in a 24 pin DIL. 2 or 4 devices can be stacked to give 7 or 8 bit conversion. From £35.63 *ENGINEERS*

GENERAL INSTRUMENT
GENERAL INSTRUMENT SP 0256 speech synthesis chip 28-lead LSI device designed to generate human speech or complex sounds. Built in 16K ROM memory. External ROMs may be added to enable direct access to 4x1K bits of memory and up to 3825 sequences (words or phrases) which may be called up directly. High-quality generation may take place using about 2000 data bits per second whilst lower quality can be coded at lower bit rates. *OEMs SCIENTIFIC*

HARRIS SEMICONDUCTOR
HARRIS SEMICONDUCTOR new products include HI 516 and HI-518 high speed analogue multiplexers. [illegible] 16 channel device which can be used in either a single ended or differential mode [illegible] 8 channel and also single ended or differential selectable. HA-1600 family [illegible] precision voltage regulators and HI 5800 and HI 5801 data acquisition devices for applications in multi channel data acquisition systems, status monitoring systems, process control systems, instrumentation and military systems. Employ leadless chip carrier (LCC) fabrication techniques *OEMs SYSTEMS DESIGNERS*

HEWLETT PACKARD
HEWLETT PACKARD Model 10279A NOVA 3, Model 10280A microNOVA and Model 10285A HP 1000 L Series Minicomputer to Logic Analyser Interfaces. All connect directly to minicomputer buses and control lines. All can be used with Model 10277A/B/C/D General

BRAND NEWs

[illegible]

INPET [illegible] PET [illegible]

IMPETUS COMPUTER SYSTEMS
IMPETUS COMPUTER SYSTEMS INPET interface permits PET to use a wide variety of printers having RS232. Allows PET to be slowed down to wait for the speed of the printers if necessary. Baud rates 110 to 9600. Also allows PET to communicate directly or over phone with other larger computers. May be driven by BASIC or machine code. Fits entirely within PET. *SB MB(PET)*

INTEL
INTEL 2816 electrically erasable programmable read only memory (E2 16-kilobit nonvolatile memory, byte erasable, access time 250 nanoseconds. Flotox (floating gate tunnel-oxide) cell structure memory cells rely on Fowler Nordheim tunnelling to write and erase data (EPROMs write by attracting electrons to a polysilicon floating gate and erase them by dissipating them through exposure to ultraviolet light). 2816 erases as well as writes by electrically causing the electrons to tunnel across a thin layer (less than 200 Angstroms) of silicon dioxide). Available in prototype quantities *OEMs*

INTERSIL-DATEL
INTERSIL DATEL ADC 817 ultra fast successive approximation 12 bit hybrid Analogue-to-Digital (A/D) converter. Accomplishes 12 bit A/D conversion with ½LSB maximum integral and differential linearity errors in less than 2 microseconds. Output coding pin selectable for straight binary, offset binary or 2s complement in parallel or serial format. Applications directed to fast data acquisition systems, sound imaging and precision instrumentation. 32 pin hermetically sealed ceramic DIP package. *OEMs SCIENTIFIC*

STEP 3 [illegible] development instrument from ISG Data Sales Ltd

ISG DATA SALES LTD
ISG DATA SALES LTD STEP3 Firmware Development Instrument. De-bugs code generated on other computing facilities which is then down loaded via RS232 link. Both in object code and enables user to modify main code. Will control a processor and trace its execution—single-step halt in real time on complex conditions, jam the contents of an arbitrary address, force an instruction to write a register or start a program from an arbitrary location and examine the contents of internal registers and I/O ports. Will also N-step or M-cycle. Captures addresses, data and control information in real time to 11MHz in synchronisation with the processor clock. Sequential, combinatorial and delayed trigger modes plus conditional capture. Trace depth 250 words, trace width 32 or 80 bits, output CRT or RS232 linked to local printer or host. *PROGRAMMERS*

KENNEDY
KENNEDY Total System concept provides common peripheral interface for its Winchester Disc, cartridge tape and tape streamer products. Formatter embedded in peripheral device performs [illegible] such as motion control, data formatting and [illegible] detection, each formatter communicates with its controller through own common peripheral interface [illegible] eliminating bus conflicts, polling and [illegible] shortcomings. Formatters are self identifying, allowing controller to communicate with any device on any unit without hardware strapping or operator set up. Configuration allows transfer rate up to 2.5MB per second. *MB SB OEMs*

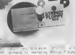
K&N ELECTRONICS LTD
K&N ELECTRONICS LTD KN800 Series Acoustic Couplers. Data transmission rates 300 baud, CCITT V24 and current loop interfaces. Full and half duplex operation options, answer mode. Batteries can be incorporated. British Post Office approved. From £180 plus VAT. *OEMs MB*

MATOR
MATOR PROTOCOL CONVERTER MPC enables connection of virtually any two computers/terminals with standard RS232 compatible communications interfaces. Synchronous and asynchronous protocols and baud rates up to 9600 handled. Compatible with Post Office telecommunications system, may be used in modem network. Software controlled, based on Multibus compatible 8085A based Single Board Computer (SBC) with max 12K PROM and 16K RAM, 2 independent RS232 communication controllers (USARTs), a real time clock and full interrupt control. *SB MB BB*

D. A. MacDONALD MICROPROCESSOR SYSTEMS
D. A. MacDONALD MICROPROCESSOR SYSTEMS SMB 09 Microcomputer Board. Uses 6809 processor and includes 8 bit by 8 bit unsigned multiply, 16 bit load, store, add, subtract and compare instructions, programmable direct page register and expanded addressing mode. RS232 serial port, parallel port configured as a Centronics type printer interface. Monitor program Debug 09 available separately. Compatible with Motorola EXORciser. *PU SB OEM*

MACHSIZE
MACHSIZE 8 bit A/D and D/A converters designed for research and educational work on the application of microcomputers. Both comprise free-standing printed circuit board with flying leads for connection to user and cassette ports of CBM PET. Feature user-selectable unipolar and bipolar voltage ranges. *PU SB MB(EDUCATIONAL RESEARCH PET)*

MBS TERMINALS LTD
MBS TERMINALS LTD MICRO SPONGE developed by Exatron Corp., general purpose RS232 interface version of Stringy Floppy digital storage device. Consists of standard Stringy Floppy drive



[illegible] purpose [illegible] RS232 [illegible] interfacing. Stringy Floppy is a digital quality magnetic tape wound in a continuous loop within a miniature cartridge. *PU SB*

FRESH IDEAS ARE GROWING AT ALTOS

Silicon Valley, California. At one time few places in the world were as abundant with orchards. Today, no other area is as technologically fertile. And nowhere on earth is the business climate as prolific with computer innovation.

Yet within this competitive environment, one microcomputer firm continues to grow above the rest. Altos Computer Systems. Recognized as a world leader in single board microcomputer technology, Altos flourishes on its ability to produce ideas and deliver them to the market while they're still fresh and packed with price performance value.

Ideas like Altos' new ACS8000-6/MTU single board microcomputer system with a DEI ¼ inch cartridge tape back-up drive, and Shugart's 8 inch floppy and 14 inch Winchester hard disk drives, with total on-line capacities from 14.5 M Bytes to 58 M Bytes.

The ACS8000-6/MTU joins Altos' growing family of products that branch out to a multitude of single board system configurations to serve the OEM, the business sector and many other end users. These systems range from the ACS8000-2 with its dual 8-inch floppy disk drives, to the powerful ACS8000-5, which is upgradable to any of Altos' hard disk and multi-user systems.

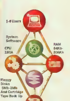
Altos supports three industry standard operating systems: single/multi-user CP/M and MP/M.* Seven high level programming languages are offered which are CP/M and MP/M compatible.

Ideas aren't the only things growing at Altos. In three years over 5000 field-proven microcomputer systems have been shipped worldwide to an ever-increasing customer base of over 300 companies. And recently a new facility has been acquired, expanding Altos' plot to over one-and-a-half acres of production facilities.

Weed through the micro computer system alternatives. No matter what your application, you'll pick Altos.

For specific details about pricing or performance, call or write

Logitek E.I.C. Electronics Ltd.,
8-10 Fazakerley Street, Chorley,
Lancs. PR7 1SJ
Tel. 025 72 67615/66803
Telex 667354, Cables Logtek.


1-4 Users
System Software
CPU Z80A
RAM 64Kb-208Kb
Floppy Disks 5Mb-2Mb And Cartridge Tape Back Up
Winchester Disk. 14.5Mb-58Mb

Packed with Fresh Ideas

ALTOS
COMPUTER SYSTEMS

*CP/M and MP/M are registered trademarks of Digital Research, Inc. OEM enquiries welcome © 1980 Altos Computer Systems.

Why the Sinclair ZX80 is Britain's best selling

Built: £99.95

Including VAT post and packing free course in computing Learning

Kit: £79.95

Including VAT post and packing free course in computing

This is the ZX80 A really powerful, full facility computer matching or surpassing other personal computers at several times the price "Personal Computer World" gave it 5 stars for excellent value Benchmark tests say it s faster than all previous personal computers

Programmed in BASIC – the world s most popular language – the ZX80 is suitable for beginners and experts alike And response from enthusiasts has been tremendous – over 20 000 ZX80s have been sold so far!

Powerful ROM and BASIC interpreter

The 4K BASIC ROM offers remarkable programming advantages

- * Unique one touch key word entry the ZX80 eliminates a great deal of tiresome typing Key words (RUN PRINT, LIST etc) have their own single key entry
- * Unique syntax check. A cursor identifies errors immediately
- * Excellent string handling capability – takes up to 26 string variables of any length All strings can undergo all relational tests (e g comparison)
- * Up to 26 single dimension arrays
- * FOR/NEXT loops nested up to 26
- * Variable names of any length
- * BASIC language also handles full Boolean arithmetic conditional expressions etc
- * Randomise function useful for games and secret codes as well as more serious applications
- * Timer under program control
- * PEEK and POKE enable entry of machine code instructions
- * High-resolution graphics
- * Lines of unlimited length

Unique RAM

The ZX80 s 1K-BYTE RAM is the equivalent of up to 4K BYTES in a conventional computer – typically storing 100 lines of BASIC

No other personal computer offers this unique combination of high capability and low price

The ZX80 as a family learning aid Children of 10 years and upwards are quick to understand the principles of computing and enjoy their personal computer

The Sinclair teach-yourself BASIC manual

If the specifications of the Sinclair ZX80 mean little to you – don t worry They re all explained in the specially-written 128 page book (free with every ZX80) The book makes learning easy exciting and enjoyable and represents a complete course in BASIC programming – from first principles to complex programs

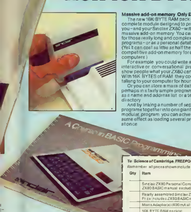
Kit or built – it's up to you

In kit form the ZX80 is pleasantly easy to assemble using a fine tipped soldering iron And you may already have a suitable mains adaptor – 600 mA at 9V DC nominal unregulated If not, see the coupon

Both kit and built versions come complete with all necessary leads to connect to your TV (colour or black and white) and cassette recorder Plug in and you re ready to go (Built versions come with mains adaptor)

g personal computer.

Now available for the ZX80...
New 16K-BYTE RAM pack



Massive add-on memory. Only £49.95.

The new 16K-BYTE RAM pack is a complete module designed to provide you – and your Sinclair ZX80 – with massive add-on memory. You can use it for those really long and complex programs – or as a personal database. (Yet it can cost as little as half the price of competitive add-on memory for other computers.)

For example, you could write an interactive or 'conversational' program to show people what your ZX80 can do. With 16K-BYTES of RAM, they could be talking to your computer for hours!

Or you can store a mass of data – perhaps in a fairly simple program – such as a name and address list, or a telephone directory.

And by linking a number of separate programs together into one giant but modular program, you can achieve the same effect as loading several programs at once.

We're also confident that it won't be long before you can buy cassette-based software using the full 16K-BYTE RAM. So keep an eye on the personal computer magazines – and brush up your chess perhaps!

The RAM pack simply plugs into the existing expansion port on the rear of the ZX80. No wires, no soldering. It's a matter of seconds and you don't need another power supply. You can only add one RAM pack to your ZX80 – but with 16K-BYTES who could want more!

How to order

Demand for the ZX80 exceeds all other personal computers put together! So use the coupon to order today for the earliest possible delivery. All orders will be despatched in strict rotation. We'll acknowledge each order by return, and tell you exactly when your ZX80 will be delivered. If you choose not to wait, you can cancel your order immediately, and your money will be refunded at once. Again, of course, you may return your ZX80 as received within 14 days for a full refund. We want you to be satisfied beyond all doubt – and we have no doubt that you will be.

sinclair
ZX80
Science of Cambridge Ltd.
6 Kings Parade, Cambridge, Cambs.,
CB2 1SN. Tel: 0223 311488.

To: Science of Cambridge, FREEPOST 7, Cambridge CB2 1YY.

Remember: all prices shown include VAT, postage and packing. No hidden extras. Please send me:

Qty	Item	Code	Item price £	Total £
	Sinclair ZX80 Personal Computer kit(s). Price includes ZX80 BASIC manual, excludes mains adaptor.	02	79.95	
	Ready assembled Sinclair ZX80 Personal Computer(s). Price includes ZX80 BASIC manual and mains adaptor.	01	99.95	
	Mains Adaptor(s) (600 mA at 9V DC nominal unregulated).	03	8.65	
	16K-BYTE RAM pack(s).	18	49.95	
	Sinclair ZX80 Manual(s). (Free manual with every ZX80 kit or ready-made computer.)	06	5.00	

NB. Your Sinclair ZX80 may qualify as a business expense. **TOTAL £**

I enclose a cheque/postal order payable to Science of Cambridge Ltd for £ ______

Please print

Name: Mr/Mrs/Miss ______

Address ______

FREEPOST – no stamp needed. CAC03

We are now entering our fourth financial year of dealing solely in the personal computer sector – in fact, we [illegible] this period, Personal Computers Limited have formed a group of [illegible] [illegible] who will help you in the fields of word processing, financial planning, [illegible] [illegible] [illegible] [illegible] systems, foreign exchange, banking and [illegible] [illegible] [illegible] [illegible] [illegible] and [illegible] graphics and highly [illegible] [illegible] [illegible] and our [illegible] the Apple.

We can also offer [illegible] items of software – [illegible] and Visicalc – at a combined price of [illegible] V.A.T.

[illegible] (above left)
[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the power [illegible]

[illegible] Serial and Parallel Card (above centre)
[illegible]

Light Pen (above right)
[illegible]

80 Character Card *(below left)*
... opens up the real commercial world for all Apple owners.

Paper Tiger *(Below centre)*
132 character line, plus graphics, 8 character sizes, ordinary paper, multiple copy, upper and lower case 96 character, parallel/serial, Form control

[illegible]ntronics 730 *(Below right)*
A [illegible] robust printer from a major manufacturer 3 way paper handling system. 100 character per second. Special low-cost including [illegible] 96 characters

[illegible]

Sorcerer [illegible]
A [illegible] self contained, versatile and [illegible] V.A.T. [illegible] the Zilog Z80 now the easy [illegible]

[illegible]
[illegible] applications.

[illegible]
[illegible] supply, essential [illegible]

[illegible]
[illegible]

This is what we do..

and we do it rather well!

Personal Computers Limited

MICROCOMPUTER SYSTEMS CORP
MICROCOMPUTER SYSTEMS CORP MCS-8306 controller links Shugart's ST 506 micro Winchester disk drive to host computers using general purpose interface bus (GPIB) standard *OEMs MB*

MICROPROCESSOR SERVICES LTD
MICROPROCESSOR SERVICES LTD BACKUP unit for CBM PET or printer. Battery powered rechargeable nickel cadmium cells sustain operation for up to 20 minutes. Installation should be carried out by Commodore dealer *PU SB (PET)*

MODULAR TECHNOLOGY
MODULAR TECHNOLOGY INTERLASER system enables organisations to communicate over many kilometres between locations within sight of one another. Can be used to communicate as a telephone or as a data terminal using standard data and telephone interfaces. Voice and/or data circuitry contained in plug in cards. Handles medium speed data transmission from 0–50kbps asynchronous or up to 19.2kbps synchronous with or without voice transmission. High speed synchronous transmission up to 0.5Mbps or voice only. In data mode unit is fully transparent and operates in full duplex. Telephone operation also full duplex and may be simultaneous with data *MB BB*

NEWTONS LABORATORIES
NEWTONS LABORATORIES MD10 Cartridge Disc Controller interfaces S100 microcomputers with industry standard 10MB (5MB fixed 5MB cartridge) disc drives. On board 8085 processor, 1024 bytes RAM bootstrap PROM. Data transfer rate 2.5 million bits/sec between controller and drive. Accepts interrupts and performs CRC error checking. Transfers 8-bit data between CPU and controller and serial data between controller and disc drives. Data buffer holds 1024 bytes. Discs are hard-sectored and blocksizes are either 256 or 512 bytes *OEM MB (S100)*

PLESSEY
PLESSEY MJ2841 first in first out (FIFO) memory stack organised as 64 by 4 bit words. Designed using N-channel MOS process and operates from single 5V supply rail. Data rate 1.75MHz guaranteed (typically 4MHz). Plug in replacement for Fairchild 3341 and AMD's AM 2841 available in 16 lead ceramic or plastic package *OEMs*

PORTABLE MICROSYSTEMS
PORTABLE MICROSYSTEMS DRAM PLUS (A65 DRAM) memory system for use with Rockwell AIM65 microcomputer. 16 or 32Kbyte capacity features 4116 16Kbit memory device. Includes on-board EPROM programmer which can handle all 4 types of EPROM (2716/1516 (2K) and 2732/2532 (4K)). Additional provision for up to 16K of ROM/EPROM with 8 sockets. Also provided is prototyping area for developing circuits for use as memory write protection, floppy disk controller, communications. [illegible] A/D. £296 [illegible]

[illegible] Microsystems' [illegible] board for AIM-65

PORTABLE MICROSYSTEMS LTD
PORTABLE MICROSYSTEMS LTD VIDEO PLUS A65–VID for use with AIM, SYM and KIM 6502 based micros. Operating software available on cassette tape with Rockwell or KIM tape formats supported or in EPROM. Automatically adjusts to 40 by 20 or 80 by 20 screen widths and can be programmed for display formats up to 100 by 20 or 48 by 20 depending on whether video monitor or TV used. Upper and lower case ASCII characters in ROM with optional Programmable Character Generator with up to 128 additional user defined characters. £188 plus VAT *3M MB OEM (AIM KIM SYM)*

BRAND NEWs

RAPID RECALL
RAPID RECALL Intellec Series II Model 787 16 bit microcomputer development system. Designed to speed up development of APX 86/88 (8086/8088) processor application programs. Comprises two central processors (8085 and APX-86/10 (8086)), CRT monitor and keyboard, integral 8" floppy disk drive, 150K RAM and power supply. Optional hard disk provides up to 7.5 Mbytes of on line storage with average access time 30ms. 16-bit linker, locator and assembler, PL/M, Pascal and FORTRAN. Development tools include resident applications debugger and in circuit emulators *SYSTEMS DESIGNERS PROGRAMMERS (8086/8088)*

RCS MICROSYSTEMS LTD
RCS MICROSYSTEMS LTD range of microprocessor application modules based on Motorola 6800 processor packaged in PCBs for rack mounting. Modules include 32Kbyte dynamic RAM, Twin 21 column Impact Printer Interface, Dual Digital Cassette Interface, 12 bit A/D and D/A converters and a 32 bit parallel I/O module. EXORciser bus compatible. Ideally suited to the production of medium and small quantities of microprocessor based systems *OEMs PU*

RCS Microsystems' range of microprocessor application modules

SCICON
SCICON new communications products: SPI Packet Interface X.25 Protocol Converter for interfacing Public Packet Switching Networks using X.25 protocols to non X.25 terminals and systems. SLM Local Multiplexors provide for local data distribution over telephone type wires, fibre optic links etc. STX Terminal Exchange microprocessor controlled exchange. SVS Video Switch to enable switching of terminals between controllers without impedance problems. SMCW 11 range of PDP-11 based remote workstations with IBM and Univac 1100 communications capabilities *BB (COMMUNICATIONS)*

SIRIUS CYBERNETICS LTD
SIRIUS CYBERNETICS LTD Programmable Sound Synthesizer board for SWTPC S50 bus 6800 and 6809 computers. Consists of assembled and tested S30 slot printed circuit board and driving software enabling 16 internal registers of synthesizer chip (AY 3-8910) to be programmed from driving assembly language or BASIC programs. 2 bidirectional 8-bit ports provided connect keyboards or games paddles to host computer. £60 plus VAT *PU MUSICIANS EDUCATIONAL*

SMALL SYSTEMS ESGINEERING LTD
SMALL SYSTEMS ENGINEERING LTD 8048 Family Single Chip Computer Development Card. Programs 8748 microcomputer with code from either an external source or from the object code produced by the SSEL CP/M compatible cross assembler. Card in conjunction with standard UV PROM eraser makes flexible and economic development system. £285 plus VAT *SYSTEMS DESIGNERS PROGRAMMERS (8048)*

STAG ELECTRONIC DESIGNS LTD
STAG ELECTRONIC DESIGNS LTD MICROTEST high throughput VLSI Tester. Based on Stag Personality Module Concept provides over 600 dedicated and specialised pin electronics to cover complete range of required stimuli and responses. Personality modules create a concentrated test environment housing all necessary interconnections as well as support circuitry. Modules are available [illegible] CPU families. Data entry and programming [illegible] ASCII keyboard. Integral floppy disk unit *ENGINEERS*

WESSEX ELECTRONICS LTD
WESSEX ELECTRONICS LTD Model 5024 10MHz 4 Channel Oscilloscope. Features high brightness 8 by 10 CRT [illegible] trigger [illegible] XY

mode, mains or battery [illegible] X 10 attenuator probes [illegible] carries coaxial cables, coaxial leads and adaptors *ENGINEERS SCIENTIFIC*

Bureaux, Consultancies, Services, Shops

ALACRA
ALACRA new [illegible] complete stationery. Handles [illegible] paper [illegible] speeds from [illegible] to 250 feet per [illegible] 1000 [illegible] larger model [illegible] box stationery. ASTRO Table Top [illegible] single ply continuous forms [illegible] sheets up to 15" wide at rated speed [illegible] per minute *MB*

ANDREWS AIR CONDITIONING DIVISION
ANDREWS AIR CONDITIONING DIVISION PAC Portable Air Conditioner provides genuine refrigerated air to meet almost any commercial application. Two units in range offer from 8000 to 12000 Btu/h cooling capacity and can be plugged into standard mains supply. Rental from £31 per week *MB*

Andrews Air Conditioning Division's PAC Portable Air Conditioner

APL*PLUS
*APL*PLUS* complete transatlantic batch VM/CMS link now available following installation of Data 100 system. Allows customers to submit tapes and card batch input to processing on APL*Plus VM timesharing service in Washington DC. Output can be directed to magnetic tape or to line printer facilities in London *BB*

BARIC COMPUTING SERVICES LTD
BARIC COMPUTING SERVICES LTD new SALES LEDGER PLUS LEASING system added to range of

accounting packages. Aimed [illegible] and distribution market, new system [illegible] Barclays Datarange remote bank [illegible] than day to day administration is handled [illegible] in-house terminals. (Datarange terminals [illegible] CL 1500 range minicomputer) MB BB

BARRON (INSURANCE BROKERS) LTD
BARRON INSURANCE BROKERS LTD who specialise in [illegible] Fibreboard, Nedgerrie Map [illegible] new market range of insurance [illegible] beyond traditional material damage [illegible] policies to include disruption [illegible] business [illegible] damage of equipment [illegible] accidental and malicious [illegible] and computer misuse. Cover also provided [illegible] and consultants. *SB MB BB CONSULTANTS BUREAUX*

COMPUTER AND DESIGN SERVICES LTD
COMPUTER AND DESIGN SERVICES LTD (CADS) small private [illegible] specialising in writing programs to structural analysis and design. Have recently [illegible] Algol [illegible] modules PET and have produced commercially available programs including CADS2 [illegible] *STRUCTURAL ENGINEERS (PET)*

COMPUTER & ELECTRONIC EQUIPMENT CLASSIFIED
COMPUTER & ELECTRONIC EQUIPMENT CLASSIFIED. The hardware classifieds on Prestel. Hardware sellers can reach over 6000 registered Prestel users. Two basic methods of advertising (i) small ad format using 38 character lines of text and (ii) special displays using up to 7 colours and graphic movement. *PU SB MB BB*

DATA CARD
DATA CARD PHOTO IDENTITY CARDS. Tamper proof colour photo conforms to ISO and British Standards. Magnetic stripe encoding. *MB BB*

Photo-identity cards from Data Card

DATA EFFICIENCY
DATA EFFICIENCY new [illegible] Assembly VDU Desk [illegible] and £44 [illegible]

Also Terminal Screen [illegible] containing [illegible] in hair [illegible] so restoring display [illegible] ing operator efficiency [illegible] pads. *SB MB BB*

BRAND NEWs

FARS COMPUTER SERVICES LTD
FARS COMPUTER SERVICES LTD [illegible] and a [illegible] package now [illegible] APL PLUS [illegible] network as result [illegible] between Fars and APL PLUS [illegible] *SC BB*

FDS MICROFORMS LTD
FDS MICROFORMS LTD [illegible] [illegible] the COM and ass [illegible] [illegible] Like its 9700 [illegible] [illegible] COM provides a most effective and [illegible] put medium for internal [illegible] The 9700 offers an equally [illegible] effective [illegible] medium for information [illegible] be used in [illegible] requirements. *MB BB*

FERRANTI PRODUCT SUPPORT DEPARTMENT
FERRANTI PRODUCT SUPPORT DEPARTMENT now offer [illegible] range of support services to other manufacturers especially those lacking facilities in the UK. Provides in factory repair of electronic and electro mechanical equipment, spares procurement, sub assembly manufacture and a production test facility plus field technical support. Wide range of equipment support including digital and analogue circuitry, multilayer and other PCBs, LSI and microprocessor based equipment and both germanium and silicon discrete component circuitry. Gyroscopes, altimeters etc handled in a clean air environment. *MB BB*

FIND
FIND File of Industrial Data, [illegible] information source for industry which replaces time consuming and [illegible] searches through trade directories and personal knowledge. Computer based service available to anyone in industry via a telephone call. Nominal charge made to subscribers. *SB MB BB*

FORTRONIC
FORTRONIC banking systems specialists have completed [illegible] stage of setting up [illegible] service network with opening of facility in Manchester. Birmingham, Leeds, South London, Bristol and Newcastle are to follow. *MB BB*

GEC VIEWDATA BUREAU
GEC VIEWDATA BUREAU [illegible] opened [illegible] give users access by telephone to a [illegible] GEC 4000 system as if it were their own [illegible] dedicated system. Data security guaranteed. [illegible] information [illegible] GEC do [illegible] advantage [illegible] storage [illegible] updated [illegible] *MB BB*

HARLAND DATA SYSTEMS LTD
HARLAND DATA SYSTEMS LTD BAR CODE LABEL SERVICE aims at the complete elimination of mistaken identities. Unique bar codes generated in strict numerical sequence for checking via light pen or laser scanner. Any industry standard pattern of bar code can be created without possibility of duplication. Media available include self adhesive labels, [illegible] guides, tickets and bound pads. *MB BB (BAR CODES)*

ICL DATASKIL
ICL DATASKIL BALANCE THE ALTERNATIVES strategic financial planning service aimed at company directors to cash and productivity management. Service contains program PROSPER which using CBI recommended added value approach to productivity improvement planning and Dun Bradstreet Management ratio analysis of British business, generates balanced business plans linking key factors of quality, productivity and profitability. Computes management ratios, guides on desired rate of return on capital and considers cash management aspects of debtor and creditor control, stock turnover, capital expenditure and capital structure to compute cash balances. *BB*

IMPC (LONDON) LTD
IMPC (LONDON) LTD has RESIDENTIAL SALES TRAINING PLAN aimed at high technology industry to bridge the gap between people who want to sell and companies who want salespeople. IMPC recruit technical computer personnel and put them through intensive [illegible] course involving [illegible] and syndicate work [illegible] International Training Centre [illegible] Residential training costs will be absorbed [illegible] IMPC's standard recruiting fee. *MB BB*

INMAC
INMAC range of VDU EXTENSION CABLES [illegible] erate VDUs from confines of computer [illegible] EIA RS232C cable in lengths of [illegible] *SB MB BB*

INMAC [illegible] compatible extension [illegible] enable VDUs to be relocated.

KORES NORDIC (GB) LTD
KORES NORDIC (GB) LTD new range of magnetic media supplies — floppy disks, magnetic cards, printwheels and ribbons [illegible] distributed through local stationery stores. *SB MB*

LANSDOWNE RECRUITMENT
LANSDOWNE RECRUITMENT THE FIRST CONTACT PACKAGE [illegible] [illegible] with appointments Register [illegible] time Lansdowne computer [illegible] Form along with [illegible] [illegible] computer bank [illegible] companies have equal access [illegible] fee [illegible] positively matched [illegible] companies [illegible] Lansdowne [illegible] manage a staff. *MB BB*

LETHARBY
LETHARBY has acquired [illegible] SYSTEMFORM range [illegible] processing equipment including B[illegible] and Collators Model 2046 [illegible] 12 [illegible] pan [illegible] sets per hour. *MB BB*

LION MICRO-COMPUTERS
LION MICRO-COMPUTERS new [illegible] 200 [illegible] demonstration [illegible] tenham Court Rd centre and opening [illegible] store at 21 [illegible] St Brighton Sussex [illegible] Apple dealer in Brighton. *PU SB MB (APPLE [illegible])*

MICRO COMPUTER CENTRE
MICRO COMPUTER CENTRE HEALTH INSURANCE scheme for micro users. Available to PET and Apple users within 50 miles radius of [illegible] Annual fee of £[illegible]-15[illegible] [illegible] buys regular maintenance [illegible] service [illegible] and guarantee that system will never be down for more than 24 hours. *SB MB PET APPLE*

MONOTYPE COMMUNICATIONS LTD
MONOTYPE COMMUNICATIONS LTD now operates as a software house for users of Omni equipment. Monotype level 8 [illegible] system software offers features of Omni's Level 6.0 but [illegible] faster and uses less file space. Features file [illegible]

BRAND NEWs

for and [illegible] MB (INTEL)

ORGA TECH
ORGA TECH MANAGEMENT [illegible] not need to [illegible] the furniture [illegible] agement responsibilities [illegible] office technique [illegible] Working [illegible] executive [illegible] work and Communication Zone allows conversation with colleagues and visitors *MB BB (MANAGERS)*

OXFORD UNIVERSITY COMPUTING LABORATORY
OXFORD UNIVERSITY COMPUTING LABORATORY [illegible] NA University Consortium Industrial Numerical Analysis. Numerical analysts from 6 universities in the UK have formed a consortium [illegible] available to British industry their combined expertise in the field [illegible] numerical analysis [illegible] that branch of mathematics having the greatest impact on the efficient use of computers for scientific computation. *MB BB (Scientific)*

PRC (BUSINESS FORMS) LTD
PRC (BUSINESS FORMS) LTD now offers 2 different types of year end tax forms as P11 substitutes to organisations with computerised payrolls. Copies available free on request. *SB MB BB*

PLUMB CONTRACTS LTD
PLUMB CONTRACTS LTD new range of FS chairs 800 Series including secretarial typists and reception visitors chairs. Ergonomically designed to ensure correct spinal support thus helping to prevent backache caused by bad posture. *SB MB BB*

PROJECT OFFICE FURNITURE LTD
PROJECT OFFICE FURNITURE LTD VDU TABLE part of 4000 range £125 *SB MB BB*

SYMOT
SYMOT [illegible] moulded multi-cellular [illegible] cases and housings for the electronics industry manufactured by [illegible] of Belgium *MB (MANUFACTURERS)*

TEMPLESTOCK
TEMPLESTOCK FLOPPY DISK STORAGE BOXES Two sizes available A5 for disks A4 for diskettes. Hold 30–40 and 60–80 disks respectively. *SB MB BB*

UNITED COMPUTING
UNITED COMPUTING new name to integrate computer services of Atkins On Line, LUCS and ON Line Systems UK. Provides local support to UK users from 9 offices in major centres throughout the country and maintains 14 multiplexors to give local call access to the 30 mainframes located in Britain and the United States. Hardware ranges from Sigmas and DEC 10 machines through to [illegible] 175s and Cray 1. *BB*

WILKES BUSINESS FORMS LTD
WILKES BUSINESS FORMS LTD have announced a MASTER MAILER Division following [illegible] of ME [illegible] (a hardcopy typewritten documents) and Special Computer Forms Divisions to specialise in [illegible] mailing systems. *MB BB*

WILLIAMS & GLYNS BANK LTD
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Exhibitions, Courses, Events

AGAR COMPUTER SERVICES LTD
AGAR COMPUTER SERVICES LTD [illegible] PROGRAMMING [illegible] designed [illegible] [illegible] programs may be [illegible] run and debugged. £57.50. Next date 7–8 and 21–22 March. *SB MB*

ALAN PEARMAN LTD
APL training courses and seminars. APL for beginners. 3 days Mar 6 23-27 Apr 27-29 May 25-27 June 22-24. Advanced APL technique 2 days March 30-31 Apr 9-10 May 28-29 June 25-26. Aspects of APL on a microcomputer seminars March 19 Watford April 30 Bristol May 21 York June 18 Manchester. Courses held at Mollington Banastre Hotel Cheshire. Fees £185 £135 and £15 plus VAT. Resp. *SB MB (APL)*

ANALOGIC
ANALOGIC series of seminars for those interested in using array processors in applications which require high speed arithmetic processing. Free. 8 April Royal Scot Hotel Edinburgh 11 May [illegible] Hotel Bristol [illegible] June Analogic Offices [illegible] *BB (ARRAY PROCESSORS)*

ARTICLE NUMBER ASSOCIATION
ARTICLE NUMBER ASSOCIATION day conference on ARTICLE NUMBERING BAR CODING and SCANNING—ARTICLE NUMBERING THE FUTURE IS NOW. Includes papers on electronic [illegible] impact on invoicing procedures [illegible] weight [illegible] status of scanning [illegible] Fee [illegible] to non-members [illegible] refreshments and lunch. Queen Elizabeth Hall South Bank London. March 26. *MB BB (ARTICLE NUMBERING)*

AUTOMAN 81
AUTOMAN 81 exhibition of Robotics. Metropole Centre Brighton. May 19–21 1981. *MB BB (ROBOTICS)*

BETA
BETA BUSINESS EQUIPMENT TRADE FAIR London 1–3 March. SCOTTISH BUSINESS SHOW Glasgow 16–20 March. Meetings: COUNCIL 10 March. WORD PROCESSING DIVISION 25 March. *SB MB BB*

COMMODORE
COMMODORE training courses at Skyway Hotel Heathrow. BEGINNERS BASIC (3 days) Mar 17 £175. DISK UTILISATION I (2 days) Mar 4 £175. ASSEMBLY LANGUAGE (3 days) Mar 31 £275. PET INTERFACING (2 days) Mar 2 £175. ADVANCED PROGRAMMING (3 days) Mar 24 £275. DISK UTILISATION II (2 days) £175. 3000 SERIES SERVICE (3 days) Mar 9 £450. 8000 SERIES SERVICE (1 day) Mar 6 £30. CONTROL SEMINAR (1 day) Mar 20 £50. *SB MB (PET)*

CONTROL DATA
CONTROL DATA INSTITUTE course EFFECTIVE COBOL PROGRAMMING. 5 days for programmers with 9–12 months experience to improve appreciation of COBOL. £400 plus VAT. Control Data House March 16–20. *PROGRAMMERS (COBOL)*

DESIGN COUNCIL
DESIGN COUNCIL short courses on aspects of design for managers, engineers and careers advisers. MICROPROCESSORS 2 April University of Salford. INDUSTRIAL DESIGN FOR ENGINEERS 6–10 April Maryland College Woburn. DESIGN CAREERS IN INDUSTRY 23 June Colwyn Bay. ENGINEERING DESIGN CONFERENCE 15–16 September Cambridge. INDUSTRIAL DESIGN FOR ENGINEERS 2–6 November Maryland College Woburn. Fees to be advised. *MANAGERS ENGINEERS CAREERS OFFICERS*

HOSKYNS
HOSKYNS advanced techniques courses on STRUCTURED ANALYSIS AND DESIGN and DATABASE DESIGN at Bournemouth and Harrogate. Both 5-day residential courses. Former aimed at systems analysts with or without formal training and senior project staff and managers. Latter aimed at analysts and designers using database management systems and involved in the design of the database itself. £380 each, accommodation extra. Structured Analysis 23 March, 1 June, 20 & 28 July, 28 Sept & 23 Nov. Database 30 March, 15 June, 10 August, 12 Oct, 7 Dec. *SYSTEMS ANALYSTS AND DESIGNERS*

INFOTECH
INFOTECH Technology Briefing NETWORK PERFORMANCE: explains key factors affecting network performance, assesses the main performance improvement techniques currently available, and shows how to evaluate options. 9–11 March 1981. Also State of the Art Tutorial PRIVATE DATA NETWORKS 22–24 April 1981. For senior executives and technical staff responsible for information processing and communications [illegible] analyses latest issues and technological advances that influence organisations' policies on installing and using private networks. *MB BB (NETWORKS)*

INSTITUTE OF DIRECTORS
INSTITUTE OF DIRECTORS course programme for 1981 includes COMPUTERS AND STRATEGIC PLANNING 2 day residential at Hedsor Park, Taplow, Maidenhead, Berks. Covers computer concepts and fundamentals, roles and steps in DP development, choice of equipment, database concepts, making the best use of computer, strategic approach to systems development, modelling as a corporate planning aid, trends in data processing. *MANAGERS DIRECTORS*

ICS PUBLISHING CO (UK) LTD
ICS PUBLISHING CO (UK) LTD courses DIGITAL FILTERS AND SPECTRAL ANALYSIS 4 days 3–6 March, ICS/PCL Microcomputer Unit, Polytechnic of Central London. Examines the fundamental algorithms of digital filters and spectral analysis with advanced software techniques and hardware architectures. Designed for project and design engineers, programmers and technical managers. CAD CAM FOR PRINTED CIRCUIT BOARDS 10–13 March Imperial Hotel WC1 [illegible] provides a practical foundation in the application of computer aided design and manufacturing for automated printed circuit board design, fabrication and test [illegible] designed for managers, engineers and designers. PROGRAMMING IN ADA 10–13 March ICS/PCL Microcomputer Unit. Provides a comprehensive introduction to the language, its structure, features and support environment for programmers, systems analysts, software engineers, program and project managers. COMPUTERISED ROBOTS 17–20 March ICS/PCL Microcomputer Unit. Provides a comprehensive introduction to computerised robot technology and practical techniques for identifying and implementing robot application. For production and technical managers, design and manufacturing engineers, systems analysts and programmers. *SB MB BB*

INTERNATIONAL WORD PROCESSING EXHIBITION AND CONFERENCE
INTERNATIONAL WORD PROCESSING EXHIBITION AND CONFERENCE Wembley Conference Centre June 23–26 1981. Nearly 90% of available space now booked. *SB MB BB*

LONDON CHAMBER OF COMMERCE AND INDUSTRY
LONDON CHAMBER OF COMMERCE AND INDUSTRY repeat of the practical seminar COMPUTER BUREAUX v MINI v MICROCOMPUTERS—CHOOSING BETWEEN A BUREAU AND YOUR OWN MINI/MICRO COMPUTER. Of particular interest to small and medium-sized companies either as potential first time computer users or as existing users contemplating change. 24 March 1981, LCCI Rooms 1&2, 2nd floor. £23 & £30 for members and non-members respectively (plus VAT). *SB MB*

MELROSE FILM PRODUCTIONS
MELROSE FILM PRODUCTIONS training film WHATS SO SPECIAL ABOUT COMPUTERS? produced in association with Peat Marwick Mitchell & Co. 34 minute video-cassette £425 plus VAT. Hire £65 (2 days), £85 (7 days) plus VAT. Directed at managers and supervisors in users departments [illegible] aims to improve communication between computer specialists and users and so enable managers to get what they need from the computer and help computer staff provide a better service. Film a fictionalised account of first 12 months of computer system with all attendant problems. *SB MB*

BRAND NEWs

MICRO CITY 81

MICRO CITY 81 International Trade and Industries Fair of Micro Electronics and Leading Edge Technology. In association with the City of Bristol supported by the Department of Industry and the University of Bristol. Sponsored by the Bristol Chamber of Commerce organised by Eurofairs Ltd. First international exhibition to encompass the full spectrum of leading edge technology in the microelection cs [illegible] to be held in Britain and will provide a sales and advisory platform for those involved in the development, manufacture and application of the microprocessor. Will span Communications and Commerce, the Electronics Industry proper, Engineering Applications and Robotics and Transport and Vehicle Technology. Professor Raymond Curnow will be Senior Advisor to co[illegible] three day conference investigating problems and opportunities arising from micro-technological development. 11–14 May 1981 Bristol Exhibition Complex. *SB MB BB*

MICROSYSTEMS 81

MICROSYSTEMS 81 exhibition Wembley Conference Centre 11–13 March 1981 *PL SB MB*

MSS COMPUTER AND BUSINESS CONSULTANCY LTD

MSS COMPUTER AND BUSINESS CONSULTANCY LTD courses in Worthing during March. Inventory Management & Control 2–4 Computer Systems Designs & Implementation 2–6 Principles of O&M 9–12 Project Management & Control in DP 9–13 *SB MB BB*

SIA

SIA programme of seminars to 1981 released. Seminars during March include Finite Element Structural Analysis at SIA. Frame Structural Analysis with LEAP 4+. SIA/ECONOMETRICS service. Project Service for Computer Aided Highway Design. Analysis of Floating Structures. SIA STATISTICS service. SIA Computer Service for Public Sector. Process Simulation and Design with PROCESS. Simulation using HOCUS. MOSS for Highway Design. *MB BB (ENGINEERING SCIENTIFIC)*

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Change of Address

**Readers please note that Anadex have moved to
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LETTER FROM VENICE

Canal Knowledge

Inspiration struck in the second best café, the Florian in the Piazza San Marco. Venice is a nice place to be in winter. The midday sun is warm, the slight blue-green mist over endless canals and palaces places you firmly in a painting of your choice, and the people, with just enough tourists to go round, are friendly.

One is surrounded by art, one eats well and drinks cheaply, and the Italian for 'computer' is 'computer'.

I had bumped into a Yugoslavian person from the Royal College, who talked of plans for making an archive for the future, containing not facts, pictures or words, but *kits*, capable of being constructed into, say, a village or a tool. The point being, I suppose, that although any future survivors of our playful holocausts would probably not reconstruct our village or tool, the process itself would be the legacy.

It seemed to me that there was some stuff here to be thrashed around a bit in public. Let's take a few examples.

The communication of computer programs, for instance, is a completely new medium, isn't it? X gives to Y, on paper, disk or tape, the means of constructing a thing. I'm not talking about the mere passing-on of a program that someone will use exactly as it is, nor, alternatively, of a program that is straightforward and completely self-contained, with no possibility of emergent properties. What I refer to is a program that may or may not be altered by its new owner or user, and one which probably will yield results that are not predictable.

Take the example of a chess program. If I give you such a program, what have you received? Easy to say what *not*: not a particular game of chess, not any predictable system except in quite vague terms. Presumably it knows or contains the rules of chess, but would you find them out from inspection of the program or its results? I doubt it.

The program enables a game of chess to be played. (Chess is strictly *not* a game of course, but the number of possible moves and states is so great that it might as well be.) Is it a score for chess, *the* game or *a* game? It doesn't feel like that. There is little or nothing to be followed, and in fact one has, in a way, *more* freedom with a music score.

Let's now look at the problem from another viewpoint. (A quick note to a reader who moaned that I was always raising questions, never answering them: Oh, c'mon!) A short time ago I invested money that I have by virtue of possessing no house, hi-fi or car (I have to say that, ok? – it makes me feel better) in an electronic piano-like keyboard and an associated box that effectively turns it into a polyphonic (8 notes at once) synthesizer.

It enables me to sit in my bedroom and make music when I should be doing other things. One day I shall purchase a black cloak and a small hydraulic jack – then enter into lectures and the more desirable social gatherings from a pit cleverly concealed under the floorboards, thundering fiercely on the organ or causing a hundred violins to howl.

Anyway – this instrument: what is it? It contains no 'music' and few rules. I can program it like a computer. It has inputs and outputs (fingers and thundering). The program determines the basic sound that will be used at any one time, but this itself can be altered substantially as the music progresses. The keyboard is certainly, amongst other things, a 'tool' – but what does that mean? What *is* a programmed computer? If we can answer that question, it may help us work out what a program is.

As the last of our examples, consider the bird down the road. It sits in a restaurant here in Venice and talks and sings. Apart from imitating a cat with exemplary skill, and uttering a piercing, if clichéd rendition of the key phrases from several minor orchestral classics and the more well known woodwind concertos, the bird chatters in Italian and, now, English.

My companion, Italian but fluent in English, and with a playfully sordid imagination, grew so tired of its wolf whistles at her that she sidled up to its cage and began to teach it a phrase that, for the record, can only be described as '(deleted) off'. You will understand my personal loathing of this phrase and its purely academic* use here.

The bird cocked an ear, and was soon merrily shrieking the suggestion at all who came near, to the bafflement of the less-travelled Italian patrons.

In a way, the bird was programmed. The black bird is a kind of black box. Possibly, by study of its input, the stimuli offered to it, one could begin to predict its musical, imitative or rude output. You may argue that the phrase was data, not program. But the constant repetition of it, presumably with subtle reinforcement ('say this, bird, and I won't pull your wing off') was surely programming? Yet who can tell what the bird is singing or saying now, as you read this?

So, what would you put in an archive for the future? What programs, either literal computer programs or these more difficult ones, would you leave for someone or something to find?

I've got to dampen a towel now, and leave it over the radiator, otherwise the room gets too dry. You can't leave the window open, because the canal goes slurp slurp slurp, and wakes you up, though you'd think it would lull you to sleep, as it does the dark-prowed gondolas.

I read in La Republica that Marshall McLuhan has died. I always thought he was wrong, in saying 'the medium is the message', but can only remember two reasons, and there are always three reasons why people are wrong.

Let's make a Venice picture of it: one for the boatman, one for the boat, and one for the rowed. Buona sera. ■

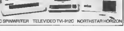
---

* *Though censored.* **Editor**

The author is at the Royal College of Art, K[illegible]ton Gore, London.

BUSINESS APPLICATION SOFTWARE

WORD PROCESSING



NEC SPINWRITER TELEVIDEO TVI-912C NORTHSTAR HORIZON

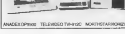
Wordstar

Probably the most powerful word processing package available on any microcomputer

WordStar features include
Print Spooling Simultaneous printing and editing
Help messages: comprehensive prompting eliminates the need to refer to a manual. Four levels user selectable
Video editing text is displayed on a screen; any change is immediately displayed. The size of the document being edited is limited only by disc capacity
Powerful editing commands text can be inserted, deleted, moved, copied or read from files. A string of data can be found and replaced with other data
Word-Wrap virtually eliminates the need for carriage returns. A word too long to fit at the end of a line is automatically moved to the next line
Dynamic page break display* shows the location of the end of a page on the screen. Dynamically updates as changes are made
Print enhancements Boldface, Double Strike, Underline, Strikeout, subscripts, superscripts, variable character pitch, variable line height and alternate type style or ribbon colour are all possible using a daisy-wheel printer
Flexible formatting the user can choose either a ragged or justified right margin, or mix both
Flexible pagination user control of page length, top and bottom margins, heading, footing/page number locations and pagination directives
Hyphen-Help alerts you when the last word on a line is too long to fit. You can choose between hyphenation or moving the whole word to the next line
Decimal Tab allows columns of numbers to be typed as easily as operating an adding machine. **WordStar** will line-up the decimals automatically
Paragraph Indent* temporarily sets the left margin to a tab stop so that documents with multiple indentations (like outlines) can be typed easily
Program Execution allows a program (such as an operating system utility) to be executed, with automatic return to **WordStar**
MailMerge (optional) is a powerful file merging tool. It can combine a file containing names and addresses with a file containing letter text, inserting data where variables are specified, even in mid paragraph. It enables "personalised" form letters to be created with a specified salutation and/or closing. The same data file can be used for both form letters and mailing labels
Multiple copy printing* allows the same file to be printed more than one time automatically
Chained printing* a file name can be specified within text. The file will later be printed automatically
*Items are features available in the optional MergePrint module at a cost of £65

MicroPro Products*
WordStar is a screen-oriented text editing and word processing program
Software*/Manual, £175/£20**
MailMerge (**WordStar** required) is a powerful file merging tool. Variables from data files are inserted in specified places within text and rejustified. Includes nested and chain printing capabilities
Software*/Manual, £65/£10**
DataStar is a system for data entry, retrieval and updating
Software*/Manual, £145/£20**

STOCK CONTROL



ANADEX DP9500 TELEVIDEO TVI-912C NORTHSTAR HORIZON

Inventory

Comprehensive Stock Control, Sales and Purchase Management System

The **INVENTORY** package consists of a suite of programs (menu driven) written in a hybrid of North Star BASIC and assembler. All input is screen oriented making use of direct cursor addressing and protected fields. All field data input is in carefully defined screen areas. This ensures that the operator cannot exceed given input field lengths. Further all input is verified by input type (alpha, numeric, alphanumeric) and field range where applicable.

INVENTORY is suitable for most medium sized inventories and is designed to run in typical retail and wholesale environments. **INVENTORY** maintains purchase and sales ledger control as well as stock control by use of built in invoice and order processing. Incorporated are special features which facilitate generation of:

1) Customer name, address and telephone lists by customer type
2) Quotations based on prices associated with customer type
3) Price lists by customer type
4) Vendor name, address and telephone list
5) Sales (customers) and Purchase (vendors) statements
6) Sales and Purchase remittance advice notes
7) Sales and Purchase accounts analyses listed alphabetically by account number. On the last page a summary of Purchase or Sales totals for current, 30 days, 60 days, and 90+ days is printed.
8) Sales and Purchase reminder letters. Provision is made for two different versions. The default paragraph for each is input during INSTALL. Optionally, prior to printing a Reminder Letter the user may enter a specific paragraph related to that Letter. Should the user decide not to use the default paragraph facility then each Reminder Letter would have a unique paragraph input by the user

Additional features include
9) Ability to customize **INVENTORY** for user's particular VDU and printer
10) Can print invoices, order acknowledges, copy invoices, credit notes and packing lists
11) Generates statements and remittance advices
12) Generates reminder letters: first and second
13) Generates orders and order copies.
14) Utilities for:
a. Percentage uplift of cost, landed and sale prices
b. Reset turnover count associated with each product.
c. Modify existing invoice, quotation and purchase order numbers.
d. Modify client type discount values
15) Stock record maintenance (add, modify, delete or leave) on all stock record fields
16) Account record maintenance (add, modify, delete or leave) on all fixed record fields
17) Transaction posting to client accounts. Facilities cash-in/cash-out and other necessary transaction adjustments. Note ORDER and INVOICE produce their own specific transaction records. Transaction categories (e.g. invoice, cash receipt etc.) are identified by transaction type
18) Stock analysis report: flags products in excess and to be ordered

Future Enhancements
The following enhancements are planned for the near future:
1 Extending the system to work in conjunction with a General Ledger package to add Bank Account Maintenance and Balance Sheet generation
2 System extension to support hard disk(s)
3 Timesharing
4 Compatability with the CP/M operating system
Inventory Package* Software*/Manual £295/£10**

***Price of Software includes manual **100% credit if software is purchased later**
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▶ *from page 31*

"not musical", "profound" or "superficial," "intelligent or dumb." Thus deficiency becomes identity and learning is transformed from the early child's free exploration of the world to a chore beset by insecurities and self-imposed restrictions.

Two major themes—that children can learn to use computers in a masterful way, and that learning to use computers can change the way they learn everything else—have shaped my research agenda on computers and education. Over the past ten years I have had the good fortune to work with a group of colleagues and students at MIT* (the LOGO group in the Artificial Intelligence Laboratory) to create environments in which children can learn to communicate with computers. The metaphor of imitating the way the child learns to talk has been constantly with us in this work and has led to a vision of education and of education research very different from the traditional ones. For people in the teaching professions, the word "education" tends to evoke "teaching," particularly classroom teaching. The goal of education research tends therefore to be focused on how to improve classroom teaching. But if, as I have stressed here, the model of successful learning is the way a child learns to talk, a process that takes place without deliberate and organized teaching, the goal set is very different. I see the classroom as an artificial and inefficient learning environment that society has been forced to invent because its informal environments fail in certain essential learning domains, such as writing or grammar or school math. I believe that the computer presence will enable us to so modify the learning environment outside the classrooms that much if not all the knowledge schools presently try to teach with such pain and expense and such limited success will be learned, as the child learns to talk, painlessly, successfully, and without organized instruction. This obviously implies that schools as we know them today will have no place in the future. But it is an open question whether they will adapt by transforming themselves into something new or wither away and be replaced.

My goal has been the design of objects that children can make theirs for themselves and in their own ways. Much of this book will describe my path through this kind of research. I begin by describing one example of a constructed computational "object-to-think-with." This is the "Turtle." (*See panel item "What is Logo?"*—**Editor**)

The central role of the Turtle should not be taken to mean that I propose it as a panacea for all educational problems. I see it as a valuable educational object, but its principal role here is to serve as a model for other objects, yet to be invented. My interest is in the process of invention of "objects-to-think-with," objects in which there is an intersection of cultural presence, embedded knowledge, and the possibility for personal identification.

The Turtle is a computer-controlled cybernetic animal. It exists within the cognitive minicultures of the "LOGO environment," LOGO being the computer language in which communication with the Turtle takes place. The Turtle serves no other purpose than of being good to program and good to think with. Some Turtles are abstract objects that live on computer screens. Others, like floor Turtles, are physical objects that can be picked up like any mechanical toy. A first encounter often begins by showing the child how a Turtle can be made to move by typing commands at a keyboard. FORWARD 100 makes the Turtle move in a straight line a distance of 100 Turtle steps of about a millimeter each. Typing RIGHT 90 causes the Turtle to pivot in place through 90 degrees. Typing PENDOWN causes the Turtle to lower a pen so as to leave a visible trace of its path while PENUP instructs it to raise the pen. Of course the child needs to explore a great deal before gaining mastery of what the numbers mean. But the task is engaging enough to carry most children through this learning process.

The idea of programming is introduced through the metaphor of teaching the Turtle a new word. This is simply done, and children often begin their programming experience by programming the Turtle to respond to new commands invented by the child such as SQUARE or TRIANGLE or SQ or TRI or whatever the child wishes, by drawing the appropriate shapes. New commands once defined can be used to define others. For example, just as the house in **Figure 1** is built out of a triangle and a square, the program for drawing it is built out of the commands for drawing a square and a triangle. Figure 1 shows four steps in the evolution of this program. From these simple drawings the younger programmer can go on in many different directions. Some work on more complex drawings, either figural or abstract. Some abandon the use of the Turtle as a drawing instrument and learn to use its touch sensors to program it to seek out or avoid objects. (*See panel item "What is Logo?"*—**Editor**) Later children learn that the computer can be programmed to make music as well as move Turtles and combine the two activities by programming Turtles to dance. Or they can move on from floor Turtles to "screen Turtles" which they program to draw moving pictures in bright colours. The examples are infinitely varied, but in each the child is learning how to exercise control over an exceptionally rich and sophisticated "micro-world."

Readers who have never seen an interactive computer display might find it hard to imagine where this can lead. As a mental exercise they might like to imagine an electronic sketchpad, a com-

What is Logo?

LOGO is the name of a philosophy of education in a growing family of computer languages that goes with it. Characteristic features of the LOGO family of languages include procedural definitions with local variables to permit recursion. Thus in LOGO it is possible to define new commands and functions which then can be used exactly like primitive ones. LOGO is an interpretive language. This means that it can be used interactively. The modern LOGO systems have full list structure, that is to say, the language can operate on lists whose members can themselves be lists, lists of lists, and so forth.

Some versions have elements of parallel processing and of message passing in order to facilitate graphics programming. An example of a powerful use of list structure is the representation of LOGO procedures themselves as lists of lists so that LOGO procedures can construct, modify, and run other LOGO procedures. Thus LOGO is not a "toy," a language only for children. The examples of simple uses of LOGO in this book do however illustrate some ways in which LOGO is special in that it is designed to provide very early and easy entry routes into programming for beginners with no prior mathematical knowledge. The subset of LOGO containing Turtle commands, the most used "entry route" for beginners, is referred to in this book as "TURTLE TALK" to take account of the fact that other computer languages, for example SMALLTALK and PASCAL, have implemented Turtles on their systems using commands originally developed in the LOGO language. The TURTLE TALK subset of LOGO is easily transportable to other languages.

It should be carefully remembered that LOGO is never conceived as a final product or offered as "the definitive language." Here I present it as a sample to show that something better is possible.

Precisely because LOGO is not a toy, but a powerful computer language, it requires considerably larger memory than less powerful languages such as BASIC. This has meant that until recently LOGO was only to be implemented on relatively large computers. With the lowering cost of memory this situation is rapidly changing. As this book goes to press, prototypes of LOGO systems are running on a 48K Apple II system and on a TI 99/4 with extended memory. Readers who would like to be kept informed of the status of LOGO implementations can write to me at **LOGO project, MIT Artificial Intelligence Laboratory, 545 Technology Square, Cambridge, Mass. 02139.** See S. Papert et al. *LOGO: A Language for Learning* (Morristown, N.J.: Creative Computing Press, forthcoming, Summer 1980).

The history of the Turtle in the LOGO project is as follows. In 1968–1969 the first class of twelve "average" seventh-grade students at the Muzzy Junior High School in Lexington, Massachusetts, worked with LOGO through the whole school year in place of their normal mathematics curriculum. At that time the LOGO system had no graphics. The students wrote programs that could translate English to "Pig Latin," programs that could play games of strategy, and programs to generate concrete poetry. This was the first confirmation that LOGO was a learnable language for computer novices. However I wanted to see the demonstration extended to fifth graders, third graders, and ultimately to preschool children. It seemed obvious that even if the LOGO language was learnable at these ages, the programming topics would not be. I proposed the Turtle as a programming domain that could be interesting to people at all ages. This expectation has subsequently been borne out by experience and the Turtle as a learning device has been widely adopted. Pioneer work in using the Turtle to teach very young children was done by Radia Perlman who demonstrated while she was a student at MIT that four-year-old children could learn to control mechanical Turtles. Cynthia Solomon used screen Turtles in the first demonstration that first graders could learn to program. At the other end of the age spectrum, it is encouraging to see that Turtle programming is being used at a college level to teach PASCAL. See Kenneth L. Bowles, *Problem Solving Using PASCAL* (New York: Springer Verlag, 1977). Controlling Turtles has proven to be an engaging activity for retarded children, for autistic children, and for children with a variety of "learning disorders." See for example Paul Goldenberg, *Special Technology for Special Children* (Baltimore: University Park Press, 1979). Turtles have been incorporated into the SMALLTALK computer system at the Xerox Palo Alto Research Center. See Alan Kay and Adele Goldberg, "Personal Dynamic Media" (Palo Alto, Calif.: Xerox, Palo Alto Research Center, 1976).

Touch Sensor Turtle. The simplest touch sensor program in LOGO is as follows:

```
TO BOUNCE                   Comments
REPEAT                      This means repeat all the
                            individual steps.
  FORWARD 1                 The turtle keeps moving.
  TEST FRONT TOUCH          It checks whether it has
                            run into something.
  IFTRUE RIGHT 180          If so, it does an about turn.
END
```

This will make the Turtle turn about when it encounters an object. A more subtle and more instructive program using the Touch Sensor Turtle is as follows:

```
REPEAT                      Comments
  FORWARD 1
  TEST LEFT TOUCH           Check. Is it touching?
  IFTRUE RIGHT 1            It thinks it's too close and
                            turns away.
  IFFALSE LEFT 1            It thinks it might lose the
                            object so it turns toward.
  END
```

This program will cause the Turtle to circumnavigate an object of any shape, provided that it starts with its left side in contact with the object (and provided that the object and any irregularities in its contour are large compared to the Turtle).

It is a very instructive project for a group of students to develop this (or an equivalent) program from first principles by acting out how they think they would use touch to get around an object and by translating their strategies into Turtle commands. ■

**Massachusetts Institute of Technology* puter graphics display of the not-too distant future This is a television screen that can display moving pictures in colour You can also "draw' on it, giving it instructions perhaps by typing perhaps by speaking or perhaps by pointing with a wand On request a palette of colours could appear on the screen You can choose a colour by pointing at it with the wand Until you change your choice the wand draws in that colour Up to this point the distinction from traditional art materials may seem slight but the distinction becomes very real when you begin to think about editing the drawing You can talk to your drawing in computer language You can tell' it to replace this colour with that Or set a drawing in motion Or make two copies and set them in counterrotating motion Or replace the colour palette with a sound palette and draw a piece of music You can file your work in computer memory and retrieve it at your pleasure or have it delivered into the memory of any of the many millions of other computers linked to the central communication network for the pleasure of your friends

That all this would be fun needs no argument But it is more than fun Very powerful kinds of learning are taking place Children working with an electronic sketchpad are learning a language for talking about shapes and fluxes of shapes about velocities and rates of change, about processes and procedures They are learning to speak mathematics and acquiring a new image of themselves as mathematicians

In my description of children working with Turtles I implied that children can learn to program For some readers this might be tantamount to the suspension of disbelief required when we enter a theatre to watch a play For them programming is a complex and marketable skill acquired by some mathematically gifted adults But my experience is very different I have seen hundreds of elementary school children learn very easily to program, and evidence is accumulating to indicate that much younger children could do so as well The children in these studies are not exceptional or rather they are exceptional in every conceivable way Some of the children were highly successful in school some were diagnosed as emotionally or cognitively disabled Some of the children were so severely afflicted by cerebral palsy that they had never purposefully manipulated physical objects Some of them had expressed their talents in 'mathematical" forms some in 'verbal' forms, and some in artistically visual or in musical' forms

Of course these children did not achieve a fluency in programming that came close to matching their use of spoken language If we take the Mathland metaphor seriously, their computer experience was more like learning French by spending a week or two on vacation in France than like living there But like children who have spent a vacation with foreign-speaking cousins, they were clearly on their way to "speaking computer"

When I have thought about what these studies mean I am left with two clear impressions First that all children will, under the right conditions, acquire a proficiency with programming that will make it one of their more advanced intellectual accomplishments Second that the "right conditions" are very different from the kind of access to computers that is now becoming established as the norm in schools The conditions necessary for the kind of relationships with a computer that I will be writing about in this book require more and freer access to the computer than educational planners currently anticipate And they require a kind of computer language and a learning environment around that language very different from those the schools are now providing They even require a kind of computer rather different from those that the schools are currently buying

My vision of a new kind of learning environment demands free contact between children and computers This could happen because the child's family buys one or a child's friends have one For purposes of discussion here (and to extend our discussion to all social groups) let us assume that it happens because schools give every one of their students his or her own powerful personal computer Most practical" people (including parents teachers school principals and foundation administrators) react to this idea in much the same way Even if computers could have all the effects you talk about it would still be impossible to put your ideas into action Where would the money come from?

What these people are saying needs to be faced squarely They are wrong Let's consider the cohort of children who will enter kindergarten in the year 1987, the Class of 2000 , and let's do some arithmetic The direct public cost of schooling a child for thirteen years from kindergarten through twelfth grade is over $20,000 today (and for the class of 2000 it may be closer to $30 000) A conservatively high estimate of the cost of supplying each of these children with a personal computer with enough power for it to serve the kinds of educational ends described in this book, and of upgrading repairing and replacing it when necessary would be about $1 000 per student distributed over thirteen years in school. Thus, computer costs" for the class of 2000 would represent only about 5 percent of the total public expenditure on education and this would be the case even if nothing else in the structure of educational costs changed because of the computer presence But in fact computers in education stand a good chance of making other aspects of education cheaper Schools might be able to reduce their cycle from thirteen years to twelve years, they might be able to take advantage of the greater autonomy the computer gives students and increase the size of classes by one or two students without decreasing the personal attention each student is given Either of these two moves would "recuperate" the computer cost

My goal is not educational economies It is not to use computation to shave a year off the time a child spends in an otherwise unchanged school or to push an extra child into an elementary school classroom The point of this little exercise in educational budget balancing' is to do something to the state of mind of my readers I have described myself as an educational utopian—not because I have projected a future of education in which children are surrounded by high technology, but because I believe that certain uses of very powerful computational technology and computational ideas can provide children with new possibilities for learning thinking and growing emotionally as well as cognitively ■

● *Seymour Papert is Professor of Mathematics and Ida Green Professor of Education at the Massachusetts Institute of Technology Mindstorms is published in Britain by the Harvester Press © 1980 Basic Books*

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WORDSTAR

The authors discuss the desirable features of a word processing package and then describe Wordstar. Readers are reminded of relevant articles in Issues 1, 8, 9, 12, 13 & 14

Introduction

Before purchasing a word processor, the reader should clarify in his own mind precisely what the word processor is required to do. Unless this is done before purchase, the reader might find that he ends up with a fancy box of tricks that fails to meet his requirements.

The Computer Services Association are carrying out a long term study on the probable effects of micro-processors in office work.* Some of their findings are:

- Reduction of staff is unlikely since only about a third of a secretary's time is spent typing. However, the existing staff may well be able to cope with future growth. Jobs of a *repetitive* nature will be minimised.
- More than half the typing is at present copied from hand-written manuscripts. There is considerable advantage in encouraging junior and middle level staff to use a word processor themselves.
- Because it is easy to change and update technical or business information, these changes are more likely to be done. The new technology will thus sharpen the company's edge.

There are three major reasons why a word processor is better than a simple typewriter and a typist.

A report, letter or legal document can be rough typed into the word-processor and a draft version of the document printed. The draft version can then be corrected and updated by simply making the changes to the copy stored by the word processor and the revised draft reprinted. This can clearly be repeated as many times as are necessary to produce a final version which can then be printed on high quality paper or a letterhead as required. No re-typing has ever occurred and no expensive letterheads have been wasted.

In other applications, each year's documentation can be stored on disk, and the new year's document produced painlessly by performing a few minor changes and then re-printing.

The second major reason for using a word-processor occurs whenever it is necessary to send a letter or sales information to a large number of people. Such 'personalised' letters cannot be photocopied, as the names and addresses would be wrong, yet it is most wasteful for a secretary to have to type ten or twenty copies of the same letter. Using a word processor, only one copy of the letter need be typed, together with a list of names and addresses. The word processor can then be left to produce one copy of the letter for each person. A similar situation arises whenever there is a need to write letters containing standard paragraphs (eg. legal documents). The typist would normally have to type these paragraphs each time they are encountered, whereas with a word processor the paragraphs could be retrieved from a library of standard paragraphs, and inserted into the document.

A third main reason is, to produce text that has a type-set appearance. This may be photo-copied, used as camera-ready material for printing, or can be printed directly onto offset litho plates. The type-set appearance is largely due to spacing the characters in a line of text so that the right hand margin is "justified" rather than having the ragged edge which is usual with typing. Another feature of word-processors is that they can produce as many "top copies" as are required without retyping. This may save a great deal of time.

The wordprocessing system

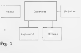

Fig. 1

A typical wordprocessing system is drawn (see Figure 1) as a set of five discrete parts: • the Keyboard • the Screen • the Printer • the Computer, and • the Disks. Each of these five plays an important role in determining the effectiveness of the complete system and they will be considered individually.

The keyboard

The keyboard is the means by which text is entered into the wordprocessing system. The following features should be considered in the choice of a keyboard:

- The keyboard must generate both upper and lower case characters for word processing. Furthermore it is essential that the keyboard can operate in typewriter mode, ie. lower case characters unless SHIFT is pressed (rather than upper case characters unless shift is pressed).

However, if the computer is to be used as a computer using languages such as BASIC or FORTRAN as well as for word processing, then upper case characters will almost certainly be needed. (One way of having the best of both worlds is to have an ALPHA lock key on the keyboard.)

The keyboard must also have a positive feel if it is to be used by a typist who is used to a typewriter. A capacitative keyboard may be good enough for a computer programmer but it will probably not do for a touch typist.

Two further features are whether the keyboard has an auto-repeat if a key is held down, and how well the keys are debounced. Poor debouncing may lead to letters being entered twice, even though the key is only pressed once. It is strongly advised that the typist who will have to use the word processor should try out the keyboard before a purchase is made.

A final point is that some word processors use Control characters for *special purposes* such as moving the cursor, editing or for commands. It may be desirable to have a separate key for each of the more common commands, in which case a keyboard with additional keys will be required. It is worth remembering that keys must be wired or programmed to perform the required function, and this may require specialist help.

The screen

- The following features should be considered with respect to the screen:

a Apart from lineprinter paper, the most common paper sizes in use allow between 60 and 80 characters per line. It is essential that the screen can display 80 characters per line so that the text can be displayed on the screen exactly as it will appear when printed on paper.

b The display of lower case letters on many screens is poor because they lack true lower case descenders. What this means is that the tail on the letters q, y, p, g, and j does not go beneath the line. This makes the text hard to read and should be avoided. The number of dots in the matrix from which characters are formed also affects clarity and resolution.

c The screen must be flicker free and glitch free. *Flicker* is general flashing of the whole screen at all times, whereas *glitches* are random spots of snow appearing on the screen whenever new characters are being added. Both of these are distracting and annoying if long periods are spent looking at the screen.

d Some people prefer green screens to the more usual white-on-black screens, since the former are said to be more relaxing and cause less eye strain.

e The physical size of the screen is important since the characters displayed must be a reasonable size. Almost all video terminals have a 12 inch diameter screen. If a larger screen is required then a professional monitor should be used.

f Some wordprocessors take advantage of inverse video (black on white) or half intensity as a means of highlighting text.

g The speed of the screen, ie. the numbers of characters it can receive per second, determines how fast text can be manipulated on the screen.

The printer

- The printer chosen may produce high quality print (as good as, or better than, an electric typewriter) or low quality print (with characters made out of a matrix of dots). The type of printer purchased determines the final appearance of the processed text Matrix dot printers generally print much faster (at speeds up to 200 characters per second) whilst high-quality printers at present have a maximum speed of about 55 characters per second, and may be as slow as 25 characters per second

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*See also Lynda King Taylor's articles in Issues 8 & 14

Matrix printers are considerably cheaper but for letters or documents involving prestige a high-quality printer is recommended

Some consideration must also be given to whether the printer is to be tractor feed or friction feed A tractor feed uses special paper with holes punched at the sides whereas friction feed printers may use any paper Tractor feed keeps the paper straight, and is essential for high speed printing

For some printers it is possible to purchase a separate paper hopper into which one places a stack of individual sheets of paper (eg A4) Such a hopper saves the time and effort of loading each page individually and means that the printer can be left to print many pages without intervention and also allows headed note paper to be used easily

Many word processors support proportional spacing of text that is the lines of text are right justified by adding fractions of a space (for example 1/120 inch) between characters rather than by adding whole spaces between words Such output gives the appearance of being typeset as in a book but requires a printer that is capable of proportional printing Some printers allow a choice of 10 characters per inch or 12 characters per inch and support a wide range of character fonts A final consideration is that a printer that is going to be used in an office must be fairly quiet

The computer

■ The choice of computer must be influenced by the following two functional features

The first is that the amount of memory in the computer determines the amount of text that can be held by the computer at any one time If more text is entered then some of the text must be stored on disk. Storage on disk takes an appreciable time and slows the system down (The amount of memory available for text in a computer depends on the total amount of memory in the computer less the amount taken by the word-processing program *itself*)

The second feature is the speed of the computer's central processor This depends on which micro processor is at the heart of the computer The overall speed of the word-processor depends on the micro-processor and the software package used It is most unlikely that the speed of the word-processor will be so slow that a touch typist can out type it but the speed is important for functions like paragraph reform which may take a noticeable time

It is essential that the computer has connections for the screen and keyboard as well as the printer Whether these connections are by serial ports parallel ports or other means is unimportant

Package

There are also some non-functional features that may be important in the choice of the computer Is the fan of the computer irritatingly noisy? Is the machine portable and will it ever need to be moved?

The disks

■ The important features relating to the disk drives are their *capacity* and *speed*, that is *how much* text can they store and *how fast* can this text be transferred to and from memory? Standard (single sided, single density) 8-inch disks can hold about 240 000 characters Five-inch disks store about 80,000 or 90 000 characters in single density, single sided format, but many five-inch disks use double density, double sided or both, and correspondingly store twice or quadruple the amount of text Transfer speed is not usually a critical factor

An alternative to the 8-inch and 5-inch floppy disks described above are hard disk drives These vary from about 8 000 000 characters to about 26 000 000 characters per drive and have very fast transfer speeds However, these drives cost considerably more than floppy disks, and may cost more than the computer itself

Software

The program that the computer is running is called the computer software This makes the computer, keyboard screen printer and disks behave as a word-processor With other software, the *same* collection of pieces of hardware may act as an accounting system or a data base

The authors consider that the functions required in the software for word processing are given in the two lists below

The first list contains functions that are deemed essential for a word processor, whilst the second list comprises functions that are deemed optional (ie useful but not essential) Readers may class some of the functions in a different way to that given

Essential functions

i) The ability to tailor the page size ie set the number of lines per page, and the number of characters per line to the size of paper that is used and the ability to adjust both the left and right margins
ii) The ability to number pages automatically—starting from one by default but with the capability of starting at any number It should be noted that some word processors only allow page numbers up to 255 and thus may be an unacceptable restriction in producing a book
iii) The ability to specify the line spacing (single-spaced, double-spaced triple-spaced etc) A great deal of typing is done with one and a half spacing and the word processor must be capable of handling this
iv) The ability to edit/correct/update and save a document
v) The ability to see the final lay-out of the document on the screen before printing The lay-out should show the text formatted in the way that it will be printed including where the page breaks fall
vi) The ability to underline text easily
vii) The ability to insert standard paragraphs from a library to avoid retyping these

Desirable features

i) The ability to specify a running heading which will go at the top of each page and vary the spaces between the top of the page and the heading and the heading and the first line of text Similarly footings (a line at the bottom of each page) may be required
ii) The ability to insert page numbers into headings or footings so that page numbers may be at the top or the bottom of the page
iii) The ability to number odd numbered pages on the right and even numbered pages on the left as is common in books
iv) Most proportional printers allow the line spacing to be specified in fine units (eg in ¹⁄₄₈ of an inch) It would be desirable for the word-processor to support such fine line spacing
v) The ability to highlight text on the printer by typing each character several times At its simplest this may just be printing a character twice in the same position (double-strike) which makes it blacker than the rest of the text Alternatively it may entail printing each character a second time slightly offset from the first position (bold face) giving the impression that a heavier typeface has been used The latter can only be supported on proportional printers but gives good highlighting
vi) The ability to use subscripts and superscripts freely This is invaluable for any mathematically orientated text chemical formulae and as a means of referring to footnotes
vii) The ability to merge names and address into a standard letter, so as to produce a personalised letter For some applications it will be required that a list of names and addresses can be supplied and the word processor be left to print a personalised letter to each person on the list. It may help if the names and addresses can be read from a file that was produced with a data-base containing other information about the people in the list
viii) The ability to edit one document whilst the printer is simultaneously printing another document Thus greatly improves the throughput of a secretary
ix) The ability to print directly with several columns on a page as in newspapers or magazines This can always be done by putting the pages to be printed through the printer twice

Wordstar

General

Wordstar is a commercially available word processing program and has been used by the authors for over a year In the authors' experience, it best fits the requirements given above Wordstar was written by Micropro International as a word processing package which would run under the popular CP/M micro processor operating system It operates on a wide variety of terminals and a large range of printers Installation of the Wordstar program to the user's particular hardware configuration is easily carried out by the user with the program INSTALL (supplied with Wordstar) This asks the user to select which make of

continued on page 69 ▶

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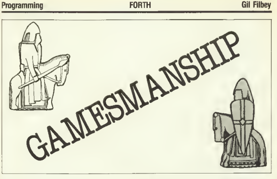

GAMESMANSHIP

A full tutorial series on FORTH began in Issue 1

I am writing this month about computer games using FORTH as the programming language *It won't matter if you don't yet programme in* FORTH (you will!) because although I shall use it to illustrate the method you should be able to follow the principles and use *any other* language with which you are familiar

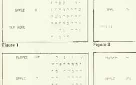

Figure 1

Figure 2

Some years ago in an exercise to study learning machines (i e machines which learn) the technique employed was that of allowing machines to learn from each other A simple matchstick game was chosen as the task to be learned and the experiment was intended to decide the question of the best kind of machine for a naive machine to learn from The choices were a) another naive machine with *no* built in learning mechanism It always made moves at random whilst respecting the rules of the game b) another naive machine which learns *along with* the tyro and c) an *expert* machine which always plays the winning line

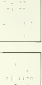

Figure 3

Figure 4

Most people would expect c) to be the best but in fact b) caused the test machine to learn in by far the shortest number of moves It is almost as if the test machine gets bored in case a) and acquires an inferiority complex in case c)!

However, this article is not about learning machines I am just leading up to the confession that, as far as computer games theory is concerned I am pretty naive but I hope to learn along with my naive readers! The blind leading the blind is not such a bad idea after all They both learn to cope Experts among you will learn nothing but tolerance

We are not going to talk about 'games' in which you take pot shots with what purports to be a LASER gun at alien objects The games we shall consider will be those in which human intelligence is pitted against machine intelligence Games such as noughts and crosses (call it tic tac toe if you must) right through to chess though I shall not try to get that far These games readily subdivide into those in which the winning line could be found in a tolerably short time by the machine and those like chess, for which this is impossible

There are it would appear to me, two different methods of tackling the latter type of problem

One is by doing a precise look-ahead to a definite depth taking into account the moves which might be made by the opponent A numerical measure is made of the value of a move and the best line assessed by a criterion called minimax which I shall discuss later

Another way is to look for broad strategic principles which will make a win more *probable* than not The difficulty here is how to assign a numerical measure to the various choices because In the end numbers are the only thing a computer understands

How do humans do it? How do I decide, when playing chess that the sacrifice of a Bishop in a certain position is worthwhile because it leads to a strong attack which I think will prove decisive? This is called experience, but I don t know how you measure it

The Bishop can be given a rough measure using pawns as a unit but its value changes with the • state of advancement of the game and by the • colour of the squares it s on

Fashion plays a large part in human play There was a time when you knew your opponent would attempt to occupy the centre squares of the chess board with pawns and maintain them there Then there came along a bunch of weirdos who avoided *occupation* of the centre in favour of long range control by pieces Bishops on the long diagonals Rooks on open files And grey heads rolled It is all part of standard chess play now but when first introduced its strength lay in its unexpectedness

Anyway to bring this rambling discourse down to brass tacks I propose to discuss a simple game presented by Professor Frey in the November 80 issue of BYTE magazine The purpose of the game was to amuse young children and to inculcate, I imagine, an understanding and command of numbers His programme was presented in Level 11 BASIC for the Tandy TRS 80 The game is played on a 'board', displayed on the VDU like a chess board with the squares labelled by random numbers from 1 to 9 The contestants, PLAYER and (in my case) APPLE, start with markers P & A in the centre of the board as shown in **Figure 1** In my VDU display I display the markers in reverse video for clarity

The players move alternately, PLAYER first one square at a time parallel to the edges of the board picking up the numbers of the squares onto which they move and adding to a cumulative score The first to reach a predetermined number, say 100, wins

To keep APPLE on the board there is a unseen border of zeros which is made a forbidden number Also zero is written into an array which represents the board in every position where either A or P have *been already*

This latter fact raises a difficulty which Professor Frey doesn t mention It is very easy to find yourself in a position where there is no legal next move Prof Frey s programme seems to contain no specific algorithm for avoiding this And indeed it is not so easy as straightforward treasure-grabbing

Suppose we play at a level of 1 ply for APPLE That is to say APPLE simply works out his best next move on the basis of the value of the number to be won without any regard to his future or to PLAYER s move It is then easy for APPLE to get *cut off* In fact he does so more often then not

I thought I would try to make him avoid this by

1) Using zero for the denuded squares (Prof Frey used 99)

2) Adding up the three numbers in the squares which flank APPLE to the left right up and down and moving not onto the square which contains the largest number but in the direction in which the three flanking squares contain the largest sum

This way APPLE tends to shun already denuded areas

To my disappointment this was worse than a philosophy of short term greed! The reason is that a slower rate of acquisition means that more of the board will be denuded before the game is over and so there will be a bigger chance of getting cut off **Figure 2** shows APPLE CLOBBERED

So I put in more greed and less caution by double weighting the actual square on to which a move is possible This gave an improvement on the performance in the straightforward treasure-grabbing case It picked up treasure at a slightly reduced rate but got cut off less often Even the human PLAYER has to do this sometimes

Now for the programmes We start on SCR # 103 by declaring some variables and arrays I try to make the names and defined words so sufficiently self explanatory that I don t need comments to remind me what they stand for Thus APPLEPLACE, and PLAYERPLACE are the current positions on the board

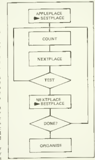

Figure 5

APPLESCORE and PLAYERSCORE are variables holding the current cumulative scores which are updated at each move and output to the video display by ASCORE and PSCORE

BEST VALUE is the contents of the adjacent square which holds the biggest treasure (or in more sophisticated algorithms it is the value you will pick up in one move of the most profitable line)

1 TEST 2 TEST etc are tests to find the best line according to a certain criterion These are chosen by means of the CASE statement So to choose 3 TEST you need to type 3 CASE!

The programme is contained in the word PLAYERMOVE which ends with APPLEPLY which sets off APPLE's reply APPLEPLY consists of two parts 'CASE @ 1 -' which selects the TEST you have chosen, and ORGANISE which just updates everything in the light of the move chosen A flow chart for this is shown in **Figure 5**

TEST in the flow chart corresponds to the parts of 1 TEST and 2 TEST etc which involve tests for legality and strategic value This is really all that needs changing for different strategies

When the programme is to be used TREASURE loads all the necessary disc screens into dictionary and the result is that STARTUP at the end of SCR # 108 returns the screen display In operation, APPLEPLACE (which is the location of A) loads into a variable BEST PLACE which will update as the test proceeds unless nowhere is legal in which case a cutoff has occurred

CLOBBERED is returned on the display NEXTPLACE is continually made a candidate for BESTPLACE till the four adjacent locations have been tried Then a move is made to whichever NEXTPLACE is considered BESTPLACE

In this article, I am considering only three tests

1 TEST is purely random legal moves Any child who can count should beat this if he avoids cutoff

2 TEST is a one-ply move to the square holding the biggest number

3 TEST is as I explained earlier a move in the direction of the biggest flanking sum as a method of avoiding the cutoff bogey

To enable APPLE to consider the moves an array called STEP is defined which moves the marker to adjacent positions in the FIELD array This latter array contains an internal image (ie in memory) of the playing field Thus

APPLEPLACE @ 1 STEP @ +

Selects the position 1 below the present one whilst APPLEPLACE @ 1 STEP @ + FIELD @ gets the contents of this position

The word CONVERT executes a conversion from a location in FIELD to a location on the video screen FIELDSHOW returns the contents of FIELD to the display (except for zeros which are left blank) Moves made by PLAYER are executed by the four keys W A S Z which form a diamond on the keyboard and cause the marker to move up, left, right or down

The complete programme is given in **Figure 6** SCR # 103 to SCR # 108 Finally **Figure 3** shows a win for PLAYER and **Figure 4** a win for APPLE Next month I shall consider some deeper strategies ■

FORTH

• FORTH is available on practically every popular machine including APPLE PET RESEARCH MACHINES UK101 TRANSAM TUSCAN and DEC machines For information on FORTH please write to Gil at the South Bank Polytechnic London SE1

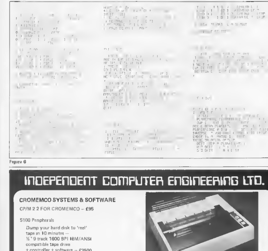

Figure 6

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This extract from the book **Understanding Communications Systems** *(published by Texas Instruments Learning Centre) is by kind permission of Texas Instruments Limited. Don L. Cannon is Associate Professor of Electrical Engineering at the University of Texas at Arlington. Gerald Luecke is Manager of Technical Products Development at the Learning Centre.*

What is communication?

Since communication is such a commonplace activity, it would seem that the answer to this question would be obvious and quite simple. Most readers should have a good idea of what communication is through their experience with it in their everyday lives. However, if one tries to define communication at very basic physical or psychological levels, the answer to this question can become very involved indeed. In fact, entire volumes have been written on the physical, theoretical, and psychological aspects of communication. It is possible to get an advanced college degree in any one of these areas of communications. Fortunately, it is not necessary or even desirable for everyone to get that involved in communication theory. It is quite sufficient to understand the fundamentals of the subject.

Definition of Communication

Communication is the transfer of meaningful information from one location (the sender, source or originator) to a second location (the destination or receiver). This definition is a basic one that only requires that the term information be defined to complete its meaning. Another name for the sender is the transmitter. In this book and in much of electronic communications systems terminology, the names transmitter and receiver are used almost exclusively. The physical path over which the information flows from transmitter to receiver is called the transmission link or the channel. These terms are diagrammed in *Figure 1*. This type of drawing is called a block diagram and is used to illustrate how the various parts work together in electronic systems. In the case of communications systems, the block diagram summarizes the flow of information in the system.

Definition of information

Information is a physical pattern that has been assigned a commonly understood meaning. The pattern must be unique (separate and distinct), capable of being sent by the transmitter, and capable of being detected and understood by the receiver. If the information is being exchanged between human communicators, it generally is transmitted in the form of sound, light, or texture patterns in a manner that can be detected by the primary human senses of hearing, sight, and feel. The receiver assumes that no information is being communicated if no recognizable patterns are being received. For example in *Figure 2*, if a person looks at a blank piece of paper or a sheet of paper with just a slash through it (*Figure 2a*), that person would most likely assume that no communication was intended. There is no pattern on the paper that is really meaningful to the person. On the other hand, a drawing of a horse, however crudely done, or the name horse spelled out in a language understood by the person (*Figure 2b*) would communicate the concept of horse to the person. The communication might still not be complete or meaningful unless the transmitter or writer and the receiver or reader both agree that seeing the symbol or the name horse meant some complete idea. Other symbols might mean a command or a warning or a reminder. Whether complete or not, information, or at least part of a communication, has been sent or transferred or transmitted from one person to another.

Information codes

If a complete command or warning or other concept has been assigned to a symbol, the information has been encoded. That is, the transmitter has used the

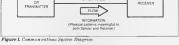

***Figure 1.** Communications System Diagram*

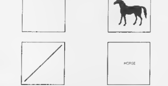

***Figure 2.** Patterns of Information*

code symbol (in the above example the horse) to transmit an entire message or command The receiver must interpret or decode this message to understand its meaning

Generally, all communications systems particularly electronic communication, use some form of coding and decoding in sending the information from the source to the destination, therefore, a typical block diagram of such a system containing encoders and decoders is shown in *Fig 3* There are two different ways in which information is encoded in communications systems

In almost all cases the information must be placed in a physical form that can be transmitted and received The encoder performs the conversion so the information can be transmitted The decoder performs the opposite conversion It takes the received information in the physical form or pattern as transmitted and converts it into a form suitable for use by the person or machine receiving the information

Using a symbol or picture, such as the picture of the horse, is a different case Here the sender and receiver have agreed that the specific physical pattern (the picture of the horse) has a complex meaning (that of a horse) So they don t really need encoding and decoding The purpose of the encoding/decoding conversions in the system is either for efficiency (a long message can be sent with a single symbol) or for secrecy (a symbol is sent that has meaning only to the sender and receiver)

Even simple and direct communications may involve either or both of these types of coding of information When one person talks to another the vocal chords of the speaker encode the information in the brain of the speaker into sound waves that can travel over the distance between the two Similarly the ear of the listener converts the patterns in the sound waves to electrical patterns meaningful to the brain of the listener This would be the encoding and decoding of the information into a physical form for transmission over the transmission link or communications channel – in this case the air between the two people If the two people were to speak in code words that have meaning only to them they are sending and receiving information and keeping it secret at the same time Both types of coding are used in electronic communications.

Introduction

Basic Communications System Parameters

Rate of Information Transfer

Before leaving the general terms and definitions of communications systems other general system requirements of specifications will be examined *Figure 4* lists several of these All of these requirements are interrelated They depend on each other, and for a given system the order of importance changes In most cases, the transfer rate of information is the most important The amount of information that must be communicated from one person to another in a certain amount of time determines the rate of information transfer The rate of information transfer will determine the physical form and techniques used to transmit and receive the information and, therefore determine the way the system is designed and constructed So frequently a prime system parameter sets the system and the other requirements fall into place behind it When information transfer rates are so low that any type system will meet the requirements then this requirement moves to the bottom of the list and one of the others takes highest priority

Rate of Information Transfer
Reliability of Information Transfer
Convenience
Cost of transferring information – money and energy

Reliability

Users must be able to depend on a communications system It must work when needed and transmit and receive information without errors

The reliability of a communications system can be affected by several factors First the system itself should almost never break down or fail to operate This can be accomplished through the use of modern electronic components in building the system, especially integrated circuits Secondly the encoding or decoding conversions, if not designed properly can cause errors in the information communicated A careful design of the encoding and decoding devices can avoid this source of error or at least minimize it Finally the presence of noise in the communications channel can mask the true signal at the receiver and prevent the receiver from providing an accurate replica of the information transmitted

Examples of the system noise are as varied as there are communications systems On a windy day the Indian smoke signals are swept away quickly preventing accurate transfer of information Trying to communicate information by talking in a rock-crushing plant is just about hopeless Writing messages in poor handwriting or on dirty or smudged paper will mask the message from the reader Electrical storms rain hail and sleet can play havoc with accurate electronic communication There is always some noise in the information transfer process The systems designer and user must make sure that the encoding and decoding process and the selection of the communications channel are such that the effects of this noise are minimized

Convenience

Many communications systems not only must be reliable but they must be convenient in order to be effective and efficient Contrast the telephone and television of today with the smoke signals of the Indians The television and telephone bring into the living room worldwide news educational materials and entertainment Within minutes personal conversations can be held with another person halfway around the world, in real time, and in voices and sounds that are familiar At best the smoke signals carry their message for 10–20 miles requiring just the right time, place and conditions before a message can be sent

Cost

The cost of a system interacts with and relates to each of the other requirements Obviously the user always wants the most performance at the least cost with good reliability and convenience In many cases, cost is the most important factor while in other cases it is only one of the deciding factors

The question of cost must be posed not only in pounds, but in terms of energy and raw materials as well While a sound warning signal could be generated by exploding an atomic bomb the cost in terms of pounds, the amount of energy used, and the loss of property would be astronomical A siren is much more cost effective The telephone is even more cost effective considering what it can do It can sound warnings carry business and personal conversations couple together computers and a lot more Its system is

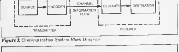

Figure 3. *Communication System Block Diagram*

Rate of Information Transfer
Reliability of Information Transfer
Convenience
Cost of transferring information — money and energy

Figure 4 *Important Communications Systems Parameters*

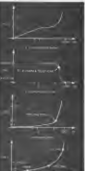

Figure 5. Man's Communications Evolution

much more expensive than the siren, but its overall cost in terms of its overall capability to each user is much more cost effective. In this case the key to determining the effectiveness of the cost of a system is in terms of its cost per unit of information transferred. Effective comparisons of the cost of alternative system approaches can be made in this fashion.

Why is communication important?

Let's examine *Figure 5a*. Much of the human race's progress in all areas has been influenced relatively directly by the ability to communicate. During primitive ages, man was limited to communications through gestures, facial and body expressions, and simple verbal utterings. His range of communication was limited to his immediate vicinity and his rate of information transfer was very low. As a result, the early social groups were autonomous, with small groups of people banding together in packs, with little interaction between such groups, except for fighting over territory and food supplies. As man's ability to communicate improved so did his social and economic situation. By the early civilizations, man's communicating ability increased to the use of spoken language, written language, and the visual and musical arts. These early civilizations had relatively complex social and political structures as well as somewhat extensive trade and commerce activities. Man had advanced through the family and tribal

Introduction

units to entire regional empires. With couriers to deliver messages and with written and spoken languages available, the range of communication extended over hundreds of miles, though the time to deliver these messages might extend into weeks. As a result, the rate of information transfer was still low, though many orders of magnitude higher than that of early civilization.

This situation remained relatively constant until the development of the printing press (1440–1460) which made large amounts of information available over a wide range of territory. Delivery of the information was still slow, depending on the relatively slow transportation systems available. However, because of much more current commercial, governmental and scientific knowledge there was a noticeable impact on the economic and social evolution. The limiting factor on the effectiveness of communication still was the rate and range of transfer of information.

This limitation was overcome dramatically with the development of the telegraph and telephone (1844–1876). The range over which man could communicate within seconds reached thousands of miles, even linking continents together. From this point, international commerce, communications and cooperation began to expand rapidly. The subsequent development of radio and then television further accelerated the transition to global interaction of people. Government and business took the lead. With the development of satellite communications systems and computer control of communications networks, the rate and range of communication today allows the global interconnection of telephone, television, and computer systems to provide fast communications to any location on earth and even beyond. It is now within a person's communicative ability to meet almost any information transfer requirement.

Society's progress has gone hand in hand with the ability to communicate. As communications systems develop further, it will be of utmost importance that each invididual keep up with the capabilities and make the best use of communications alternatives. Future success may depend on how these systems are understood and used. To help understand modern communications methods, let's review historically how man has communicated.

How have humans communicated?

Most communication in the past has been between one human and another. As a result, information has been sent in a form that is compatible with a person's physical ability to generate patterns and within the capabilities of a person's senses. The primary senses used have been hearing and sight, with some approaches using the sense of touch. The transmitter (the person sending the information) had to generate patterns of light, sound or texture. Thus, communications systems in the past used two broad techniques — visual and aural. The evolution of people's ability to use these techniques is summarized in *Figure 6*.

Communicating with sound patterns

Speech

The most common and convenient method of communicating with sound is human speech. Some say this first started

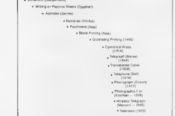

Figure 6. Evolution of the Human Race's Communication Techniques

Introduction

TELEGRAPH CHARACTERS

	Morse		Morse
A	•—	T	—
B	—•••	U	••—
C	—•—•	V	•••—
D	—••	W	•——
E	•	X	—••—
F	••—•	Y	—•——
G	——•	Z	——••
H	••••		
I	••		
J	•———	1	•————
K	—•—	2	••———
L	•—••	3	•••——
M	——	4	••••—
N	—•	5	•••••
O	———	6	—••••
P	•——•	7	——•••
Q	——•—	8	———••
R	•—•	9	————•
S	•••	0	—————

Figure 7. International Morse Code

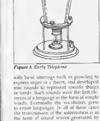

Figure 8. Early Telephone

with basic utterings such as growling to express anger or a threat, and developed into sounds to represent specific things or needs. Such sounds were the first elements of a language in the form of simple words. Eventually the vocabulary grew to entire languages. In all of these cases the transmission of the information is in the form of sound waves generated by the speaker's vocal chords. The reception of the information is by the listener's ears or hearing.

Drums

The problem with spoken language as it was originally developed is that it is relatively slow and limited in range. Even with loud yells the range of this form of communication is limited to a few hundred feet and the rate of transfer to a hundred or more words per minute. The range limitation of the sound communication was overcome early on with the use of drums or other percussion effects to generate impulses or sound energy that could carry messages over thousands of feet. By providing a network of drummers, messages could be relayed over long distances. The problem with this method was that the rate of information transfer remained severely limited. Generally, only simple warning or announcement messages could be sent. Further, a code system was necessary. Some examples might be: three drum beats means danger, or a certain pattern of drum rhythm and tones may mean that friendly visitors are approaching.

The modern version of the drum method is the telegraph developed in 1844. This was the earliest form of electrical communication. At the transmitting end a telegrapher closed a switch or telegraph key in a certain pattern of short and long closures to represent a letter of the alphabet (see Chapter 2). The electrical energy on the wire was sent in the same pattern of short and long bursts. At the receiving end this energy was converted into a pattern of sound clicks that was decoded by a telegrapher at that end. The code used by both transmitter and receiver is the Morse code (*Figure 7*). With this system and the laying of the transoceanic cable in 1858, a person's range of communication expanded to thousands of miles. The message delivery time dropped to seconds over this range, and the information rate was maintained in the 5 to 100 word per minute range. The only problem with the approach was that only skilled telegraphers could actually use the system. Everyone who wanted to send a message had to go through the telegrapher.

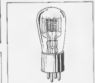

Figure 9. Vacuum Tube

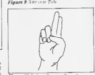

Figure 10. Indian Sign for Friend

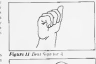

Figure 11. Deaf Sign for A

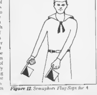

Figure 12. Semaphore Flag Sign for A

Telephone

The development of the telephone in 1876 (*Figure 8*) was again an electrical communications system. In this system the speaker's voice was converted into electrical energy patterns which could be sent over reasonably long distances over wires to a receiver which would convert these energy patterns back into the original sound waves for the listener. This system provided many of the long range communications capabilities of the telegraph, but also had the convenience of using speaking and hearing directly so that everyone could use the system. Its rate of information transfer was limited by the rate of human speech.

Wireless Telegraph

All that really changed from this point in the area of sound communications was the transmission approach. The development of wireless telegraphy in 1895, the forerunner of modern radio, allowed telegraph communications to occur over long distances without the need for running wire from the transmitter to the receiver. Now messages could be sent to mobile receivers on ships, military units and remote expeditions. The communications transmission link was electromagnetic waves that radiated from the transmitter location to the receiver location.

Wireless transmission was not practical without the perfection of the vacuum tube shown in *Figure 9* which provided the carrier frequencies at the power required in order to convert information to electromagnetic radiation.

Radio

Once man learned to encode and decode the human voice in a form that could be superimposed into electromagnetic waves and transmitted to receivers, this communication approach was used directly with human speech. Now the human voice was transmitted to remote locations thousands of miles away, picked up by receivers and converted to

continued on page 65 ▶

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	STAND ALONE	INTE-GRATED
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NOMINAL LEDGER	✓	✓
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STOCK CONTROL	✓	✓
PAYROLL	✓	✓
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WORD PROCESSING	✓	✓
DATA BASE	✓	✓
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▶ *from page 62*

speech by speakers. Radio was the first complete electronic communications system and it gave a person the capability of "yelling" from one part of earth to another or to "throw" one's voice from a point on earth to some point in space, such as the moon. Further, the travel time for the message was reduced to that available with the speed of light so that international communications occurred within fractions of seconds, and space communications occurred within seconds.

Communicating with light patterns

The first forms of visual communications occurred through facial expressions and body positions. From this point visual communications split into several alternative techniques. Some used arm and hand positions for direct communication, some used light patterns for signalling over long distances, and some used drawn pictures to point the way to food, shelter, or to tell stories.

Hand and Arm Signals

The most common hand signalling approach was through language, one of which is shown in *Figure 10*. Initially the signs were limited in number and indicated some concept such as peace, friendship, and so on. Today sign language is still being used, particularly for communication with the deaf, even to the extent of having a separate hand symbol for each alphabetical character. *Figure 11* shows the pattern for the letter A. The semaphore code is an expression in which flags are used to send letters of the alphabet. *Figure 12* shows the semaphore code for transmitting the letter A. This method has been used extensively by the Navy for communications between ships at sea.

Codes, Pictures and Signs

The use of light patterns in the form of signs or codes to provide signalling over distances was also used fairly early in man's development. The previously described Indian smoke signals were used for general announcements or warnings. Many early Indian and African tribes used rock or stick patterns to mark trails for others to follow. Even today, hobos or tramps have a trail marking sign language. *Figure 13* shows how fences are marked in front of residences to indicate the generosity or receptiveness of the occupant to beggars and tramps.

Light Patterns

Light flashes have been used throughout history to send messages. All of us are familiar with the light signalling used by Paul Revere at the Old North Church in America's revolution. The Navy has used the technique of sending coded messages from ship to ship by interrupting a light beam in a certain pattern. Morse code pulses form the alphabet just as in telegraphy. Transportation organizations such as railroads, airports, and

highway and street departments use light patterns for communicating traffic control. The traffic light is one obvious example. Railroad flagmen use lanterns moved in a certain pattern to communicate commands from one end of the train to another – from the flagman to the engineer. *Figure 14* shows the patterns used to tell the engineer to proceed and to stop. All of these light signalling methods share the features of low information rate and relatively short range communications. Typically, general commands, warnings, or status reports are being sent. In some cases, alphabetical characters are being sent, but at a fairly slow rate. The light signalling also requires a controllable source of energy in order to achieve the light communication, especially if the range is beyond a hundred feet or so.

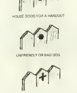

***Figure 13.** Hobo Sign Language – Fence Signs*

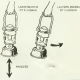

***Figure 14** Railroad Flag Patterns*

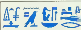

***Figure 15.** Hieroglyphics*

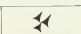

***Figure 16.** Cuneiform for Mountain*

Picture Languages and Alphabets

The most advanced form of visual communications have developed from early cave drawings that depicted events in the lives of cave-men. Before 3000 B.C. Egyptians developed a picture language shown in *Figure 15* called hieroglyphics and Babylonians developed one called cuneiform, shown in *Figure 16*. Actually, cuneiform was a triangular shaped form of writing. Around 2500 B.C. (see *Figure 6*), the Egyptians began using papyrus sheets for writing purposes, which allowed written records of events and governmental activities. The first written alphabet was devised by the Semites about 1000 years later. From that time to the A.D.'s books and libraries, numerals, shorthand, and writing paper (parchment) evolved. Late in the first 1000 years A.D., the use of ink on paper, block printing, and the present number system came into use, allowing a limited dissemination of the knowledge available at that time.

Printing Press and Photography

This rate of dissemination of information expanded rapidly once the printing press (*Figure 17*) was in operation by the 1500's. By the late 1800's, the development of photography allowed man to communicate through pictures. At about the same time the invention of the typewriter allowed the authors of written communication and information to become fairly efficient in generating the information. All of these developments had a great impact on enabling people to communicate with each other. This was most important in exchanging scientific knowledge. It continued to fuel the ever increasing rate of progress in developing a person's understanding of the physical world. This in turn enabled people to make rapid progress in developing more advanced communications techniques. With these techniques came the capabilities of transmitting pictures and written documents over long distances electronically, first through the use of facsimile (the process of sending printed material or still pictures by telephone for reproduction), and later through the use of television. The further development of satellite communication links shown in *Figure 19* provided a means for all types of information to be transmitted from a point on earth to another halfway around the world within fractions of seconds, typically 1/10 to 1/5 of a second. These later visual communications techniques had the advantage of communicating large amounts of information over large distances with small time delays. Such transmissions handle information at mil lions of bits per second Compare this to an average of 10 bits per second for information sent by a telegraph operator It was primarily through the use of electronic techniques that these tremendous improvements in people's communicative ability occurred

What is Electronic Communication?

Electronic communication uses electrical energy to transmit the information to be communicated Since electrical energy can be made to travel at the speed of light, the transfer can occur within a fraction of a second The information must be converted from its original form of sound light or mechanical energy to electrical energy This electrical energy is transmitted directly over wires and amplifiers or radiated through space to a receiver, which must convert the electrical version of the information back into its original form so that it can be understood by a person or machine

The basic components or elements of an electronic communication system are shown in *Figure 20* The source of the information can be either a person or a machine The original form of the information can be a sound pattern such as human speech, a light pattern such as a picture or written document a mechanical pattern such as a switch closure or a telegraph key or a typewriter keyboard switch or a physical variable such as temperature or pressure The original form of information must be converted to the electrical form by an encoder or energy converter This could be a telephone a television camera, a switch contact, a pressure gauge that converts pressure changes to changes in resistance, etc Once the information has been converted to electrical form it may have to be further modified or amplified to a form suitable for transmission over the wire or through space The receiver must take this form of electrical energy possibly amplify it to a large enough level, after which it is handled by the decoder or energy converter which converts the information to its final form This final form, usually the original form of the input to the transmitter, could be the sound in a telephone receiver the picture on a television set, sounds of short and long durations on a telegrapher's receiver the printing of information on paper by a typewriter, increasing hydraulic pressure with a pump, etc The receiver or destination of the information could be a man or a machine

In the above discussion the possibility of a machine being one or both participants in the communication system is included This is a real condition since modern communications systems have computers that communicate with each other and people must be able to communicate with computers if they are to use them effectively Regardless of whether the communicators are persons or machines or both it is the use of electronic means to provide the information transfer and the features of such a process that make electronic communications so important

Introduction

The fact that electronic communications is important is relatively evident from the discussion of *Figure 5*, but two system characteristics – almost instantaneous information exchange over long distances and versatility – stand out

Electronic communication has enabled people to interact in a timely fashion on a global level in social, political, economic and scientific areas This range and immediacy of electronic communications are two of the most obvious reasons why this type of communications is so important Business transactions knowledge, political decisions and social reactions can all be communicated rapidly over long range so that a person's intellectual activities are speeded up many times over what they would be without electronic communications means

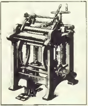

Figure 17. Early Printing Press

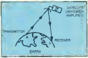

Figure 19 Communication Satellite

An equally important advantage of electronic communication lies in its versatility Almost any form of information can be encoded into electronic form transmitted and then decoded back into the desired final form at the receiver Speech music news, pictures scientific data business transactions military actions social turmoils medical telemetry entertainment, education – all can be handled electronically As a result it is almost always possible to establish a communications system that will transfer the exact types of information needed In fact, the communicator is not limited to a particular system A choice can be made between several systems to handle the transfer of the information

It is this range immediacy and versatility, that makes electronic communications a basic key to success and progress, under the assumption, of course that nations and individuals use it wisely For this reason, it is important that everyone learn and understand as much as possible about the basics of electronic communications – not the design details, but enough understanding so that intelligent decisions can be made between the alternatives available so that communications can be efficient and effective ■

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NEXT ISSUE *Computer Networks and Systems*

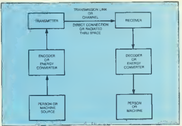

Figure 20 Elements of an Electronic Communication System

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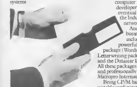

You also get the popular CP/M Operating System (from Digital Research), a 12-slot bus for easy expansion, a Z-80A CPU for powerful performance, 2 serial and one parallel interfaces, 64KB of dynamic RAM with in-built error detection capability, and dual 5" double-density drives with the option of a third drive (or quad capacity drives in place of double-density) in the same cabinet. Additionally, there is the Turbocharger option providing both enhanced disc capacity, disc performance and diagnostics. And if even greater storage is required we can supply 8" floppy drives and cartridge disc drives.

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▶ *from page 53*

terminal and printer is to be used INSTALL then creates a configured version of Wordstar for the user's particular hardware configuration as well as giving advice as to any settings that must be made on the printer or the terminal

Over 7000 copies of Wordstar were sold in one year and this must represent one of the most successful word processing packages currently on the market for 8-bit micro-computers The program has been improved (particularly in the ease with which it can be installed), through five successive releases 0 87, 0 88, 0 92 0 93, and the latest version 2 10, described below The main feature of the last release was the improved facility for personalised letter writing using mailmerge

Functions of Wordstar

To enter text the user of Wordstar just types and does not need to bother about fitting the words onto lines The text is displayed on the screen as it is typed in As soon as a word passes the right margin, the word being typed is moved to the left margin on the next line This feature is called *wordwrap* The previous line is redisplayed left and right justified The page settings default to an A4 page but the user may override the default settings to allow different page lengths or widths

The user can also specify that a new page is to begin either unconditionally, or if fewer than a specified number of lines remain when the end of a paragraph occurs Headings or footings may be specified and these may include the current page number The number of lines before and after the heading and footing can be changed

A horizontal line of dashes is shown on the screen at the point where a new page starts The line of dashes is not printed and is automatically repositioned whenever text is added or deleted Thus the user can see exactly how the text will fit onto pages when it is printed The page break display can be disabled to allow one more line of text to be displayed on the screen At all times the top line of the screen (the status line) displays the page number, the line and column at which the cursor is positioned, the name of file being edited and the command, if any that is currently being executed

On almost all printers Wordstar supports underline double strike and strikeout On proportional printers Wordstar supports, in addition boldface subscripts superscripts variable character pitch (pica elite or your choice of number of characters per inch) variable line height (6 8 or your choice of lines per inch) and alternate ribbon colour Furthermore, when printing justified text, the extra spaces required to justify each line are evenly distributed between the characters if a proportional printer is used

Editing is accomplished by moving the cursor round in the text (using control characters) to the place where a change is to be made Control character commands are then used to insert text (as opposed to overtyping and replacing the existing text) or to delete a character a whole word a complete line or a complete block Commands also exist to move a block of text to copy a block to delete a block or to output a block to disk Tabs can be set cleared or jumped to as on a typewriter (this is most useful for entering a table) The columns in which tabs are set are shown on a second line of the screen together with the current left and right margin settings (This line is called the ruler line and may be suppressed by the user if it is not used since this will free an extra line for text) Commands also exist to find or replace a string of characters or to read or write to or from additional files, and to set or to return to place markers

Four different levels of help are provided The maximum help level displays a menu showing the one-character control commands on the top part of the screen whilst editing is in progress This is most useful for beginners and avoids the necessity of referring to the manual Since the one-character commands are quickly learnt, the user soon does not require these to be displayed all of the time, and the second help-level is chosen This does not display the one character commands but prompts the user for the second character of two-character commands When the two-character commands have been learned these may also be suppressed It must be remembered that the higher the help-level selected the more commands are displayed on the screen but less text can then be displayed

Editing and printing may be performed simultaneously provided that sufficient memory exists in the computer This generally requires in excess of 48K of memory

Whenever a file is not being edited Wordstar displays the directory ie names of the files on the current disk (as well as the list of commands) During editing the directory display is usually turned off but Wordstar allows the file directory to be displayed on the screen

Hardware Supported

Wordstar supports the following list of video terminals and video boards which may be installed without any technical knowledge using the program INSTALL provided The INSTALL program provides guidance for installing other terminals and boards, although technical knowledge will be required to do this In principle any video terminal can be installed provided that it is cursor addressable and has a display of at least 16 lines of 64 characters

- Terminals & Boards which may be directly implemented with INSTALL

Beehive 150 or Cromemco 3100
Compucolor 8001G
Flashwriter I
Flashwriter II
Hazeltine 1500
Hewlett Packard 2621 A/P
Imsai V10
Infoton I–100
Lear Siegler ADM-3A or SD VDB 80 × 24
Lear Siegler ADM 31
Microterm ACT-IV
Microterm ACT-V
Perkin Elmer 550 (Bantam)
Processor Technology SOL/VDM
Soroc IQ-120
SWTPC CT-82
TEC Model 571
Televideo 912
Visual 200

Printers Supported

Any Teletype like printer
Teletype-like printer that can BACKSPACE
Diablo 1610 1620
Diablo 1640/1650
Qume Sprint 5
NEC Spinwriter 5510/5520
Half Line-Feed Printers
NEC 5500 with MicroPro I/O Master Board
Diablo Hy type II 1345 1355 1355WP with MicroPro I/O Master Board
Qume Sprint 3 with MicroPro I/O Master Board

Hardware Chosen

The authors' personal choice of hardware is given below, together with some discussion of the reasons for the choices Other users may select using different criteria, and many combinations may give *equally satisfactory results*

Computer

North Star Horizon with 56K of memory two double density disks (with 164 000 characters per disk), a fast Z80A central processor unit running at 4 MHz and the industry standard S100 bus which allows a wide range of standard boards made by other manufacturers to be plugged into the computer The machine has been extremely reliable and entirely satisfactory, and is amongst the most cost effective in its class A number of other machines would have performed equally well

Video-display and Keyboard

Initially a Lear Seigler ADM 3A visual display unit was used This is small smart looking, has a 12 inch screen displaying 24 lines of 80 characters It is cursor addressable and has upper and lower case characters provided as an optional extra Its advantages are that it is configured automatically by INSTALL, and is one of the cheapest units which can be used with Wordstar It has disadvantages in that the character matrix is small, the lower case characters do not have true descenders, and no highlighting is possible on the screen (no inverse video or half intensity) We have replaced this by an S D Systems VDB 80 × 24 video board plugged into the computer's S100 bus The board displays 24 lines of 80 characters It has extremely high quality characters formed from a matrix 8 dots wide and 12 dots deep and the lower case characters have good descenders The board offers a choice of highlighting methods either blinking, underlining or

continued on page 80 ▶

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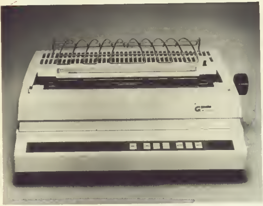

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Constant and frequent exhortations over the last thirty years about exports, pay, productivity, investment and so on have done little to advance the effectiveness of British management's performance relative to the norms of its international competitors This not withstanding the proliferation of facilities for management education, training and development at all levels

Two conclusions can be drawn from this

The first that the most significant area of influence in managements, viz the occupants of parent board-rooms, *have not been moved by the message*

Secondly since there is no shortage of education and intelligence at this level, the problem must be one of *inappropriate attitudes and values* rather than say specialist skills in subjects such as finance and selling

Of course generalisations are dangerous, the conclusions may not apply to agriculture, entertainment, the financial institutions and perhaps some other sectors, but these exceptions simply confirm that prevailing attitudes and values in these fields are the right ones Pareto's 80/20 rule probably applies 20% achieve necessary levels of performance and 80% not Desponding though this is, at least the 20% provide a possible prospect of uplift for the remainder

If attitudes and values are inappropriate and we seek to modify them significantly then because they have so many facets we must identify those most critical to business performance this, given adequate levels of entrepreneurial flair and specialist skills Widespread observation reveals three areas of outstanding importance

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The first concerns empathy – the aptitude for achieving an awareness of, and integrating with the feelings of others but take just two employee relations, and marketing

Sir Michael Edwardes promises to be the most recent in a lengthening line of managers who, faced with what can only be described as a large-scale mess, assembles a managerial team that understands the felt *real* wants of employees as distinct from how they *react* to prolonged unfulfilment

In the field of marketing Iain Dale Group Marketing Director of Dale Electric of Great Britain Ltd, is selectively quoted as follows from the December 1980 issue of the *Chartered Mechanical Engineer*

"In the last three years, Dale Electric has sold diesel generating sets in excess of £3 million value simply by using, not opposing the Japanese competitive system

We achieved this by recognising the strengths and some of the weaknesses of the Japanese international trading system then working alongside or even within the system

'Each time we've worked alongside a Japanese main contractor we have competed and successfully beaten a Japanese manufacturer often a traditional supplier in the Japanese home market to our Japanese customer

So how do we do it?

First there is no 'magic' no special formula As in all major projects we set about penetrating the Japanese third country market with good research and careful preparation

We'd noticed for example how the Japanese can be innocents abroad How their shortcomings over language and difficulty in integrating with other cultures could create opportunities for a European company prepared to do some hand holding on site, in a land foreign to both Japanese and British

' And that's particularly true with Arab markets where the punctual tiny minded Japanese mind is poles apart from the Bedouin culture and temperament A trusted European company can program in a way that an all Japanese team could not

It underlined and proved on paper our superior product the Japanese prefer non verbal communication

Their engineers invariably have language problems and find it difficult to relate to local conditions especially once taken out of the Japanese social and business Groupism in which they have grown and developed

'We recognise that the Japanese are orderly people and look for clean tidy equipment at inspection stage, they abhor discrepancies between samples and final products and simply cannot understand delays in delivery To them it's a serious breakage of a promise and that's loss of face

'We also go to great pains to be considerate and operate within a broad understanding of Japanese business customs – the use of business cards in Japanese and English the exchange of gifts the use of the midnight office the enthusiastic entertaining that builds new relationships and cements existing ones nowhere more important than in Japan where entertaining expenditure is greater than defence spending!

The second area concerns conscious aggression in the sense of a burning personal desire for changing the status quo for the better Again two examples will suffice

Firstly, the best overseas companies in like UK sectors, whether or not the effects of their competition are felt, need to be regarded as models to be *excelled*, not kept abreast of or caught up with Secondly, the definition criterion of effective management must no longer be maintenance of short-term return on capital employed, but rather *maximisation of the rate* of continuing innovation in every function of the business

Such attitudes place high premiums on curiosity and objective thinking, low premiums on habitual thinking and prejudice

The third area of need is conscious perceptions and skills in organisation in the sense of how members of groups and teams ought formally to relate to one another in terms of the roles they occupy in pursuit of an organisation's tasks The decisions inherent in these tasks ought to be the starting determinant of these role

Activities

relationships Wrong preconceived ideas about roles – in other words, organisation structuring – seriously damages effectiveness Once more, two examples will suffice at floor' level the common confusions of manager , supervisor and section leader , or charge-hand and the oft-experienced discomfort of directors of subsidiary companies

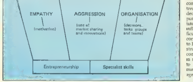
Exhaustive reading of the available literature provides none but the most general guidance for dealing with a specific organisational problem, this reinforces a general aversion to detailed interest and rationale in the subject area even though proven, well-researched realistic techniques are available Friction generated by malstructuring is often only superficially treated by a manning change or localised training, but correction enables maximum benefits from management development in the skills of leadership

The common thread in these varied aspects has to do with the attitudes and values of managers hence with their conditioning and prejudices, and inevitably, at root emotions Future management development in Britain, to the extent that it succeeds where to date it has failed has to be concerned with making an emotional impact, not a thinking one in the first instance Exhortations have failed to dent the emotions of managers beyond generating a need to reach for nationalisations for their collective failure

Where do those concerned with installing computers fit into the picture?

They play a key part in so far as their installations can merely cement existing inappropriate organisation structures or provide a real opportunity for correction bringing a widespread spin-off improvement in the effectiveness of our organisation in addition to that derived directly from the installation itself

An organisation structure is about communications, particularly co-ordinative ones intrinsically associated with the decisions inherent in its tasks Computers do not make decisions but facilitate and improve them, or ought to In influencing the choice of cementing difficulties or creating an opportunity for correction the computer installer needs to have skills in detailed organisation restructuring in local areas as well as on a company wide scale together with skills in recognising and handling the barriers to truly relevant implementation stemming from the attitudes of recipient managers, as discussed ■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Secondly the business must continue as normal while the bookkeeper and his assistant learn about the machine, its software and its idiosyncracies. For this reason David must allow the Government to pay for two school leavers to keep the manual systems going until the computer, operated by the bookkeeper's assistant, can be relied upon. I rely upon it now but I am selling not buying

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The 64k card has 24bit addressing and/or bank select operation. Its price is £450. The S100 power supply card costs £165 which includes the mains transformer, the bridge rectifier and smoothing capacitor which [illegible] do not [illegible] the card. There [illegible] floppy [illegible]

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Businessman B assumes that such routine work will get done one way or another, but would dearly love some better and more up-to-date management information so he can understand what his business is doing to him.

Neither want to know about the other's way of working. Man A secretly thinks that B is fiddling about, and that he ought to be out selling, or manufacturing, or anything else useful. Man B cannot understand how the A's of this world can exist without these vital facts.

To satisfy Man A is not too difficult. There are a wide variety of packages for doing the book-keeping. Some of the packages are not very good at producing Profit and Loss Accounts and Balance Sheets, but they will normally produce a Trial Balance which does add up, and in a useful order.

Man B's needs for management information can only be satisfied at the upper end of the market. Once you pay for computer hardware and software costing together around £16,000 then there is a greater choice and all sorts of advanced features are possible. This month I am looking at Computerplan software running on Data General Nova and CS ranges of computers as typical of this class.

Justification in routine book-keeping

To repeat the reasons why people pay money for computerising the routine work, the system should be justified on three counts.

- **To handle increasing business.** It should be possible to handle 50% more transactions with the same staff by using a computer for order processing, invoicing, sales ledger, purchase ledger, nominal ledger, stock accounting, and payroll. So if the work is now too much for your book keeper, then a computer should enable this one person to cope within the working day.
- **To produce statements and listings a few days earlier.** Earlier statements should mean earlier customer payment, which must be good. Up-to-date production of an aged debtors listing should enable you to chase defaulters more promptly.
- **To minimise the need for overtime** to handle peaks in producing invoices, statements and payslips, where these have to be produced in large batches. A computer can print these sort of documents automatically at a faster speed than the book-keeper can type.

Cash Control

Some people inherit good management tools, some build them for themselves, and, most frequently now-a-days, some people have better tools thrust upon them. With "cash distress" a national disease, bank managers are becoming even more enquiring into business affairs and are requesting, or even requiring, better management accounting before they will commit more of their money into bigger overdrafts.

Close to the bank manager's heart is the Cash Book. Better than manual records, and on a computer it is fashionable to run this as part of the Nominal Ledger, an account is assigned where a running balance is maintained of all cash transactions. Where file storage is limited then that is all you get, just the balance, chiefly to balance the trial balance. To get to the detail you have to refer back to the day book listings printed out each day. On the Computerplan package it is assumed that you have adequate disk storage, *at least 10 megabytes is normal*, and the detailed transactions are held for as long as you need them. Of course, there is a physical limit to actual disk storage. This facility is common to the whole nominal ledger; each account is tagged with a pull flag – "D" accounts are purged on demand, "P" at the end of each accounting period, "A" at year end, and "X" daily as soon as they have been listed.

One of the aspects of banking peculiar to the UK is that even after a cheque has reached the bank you still have three days to scratch together the money until it is "presented". It is therefore possible and even usual to play the system a little and live for at least three days on funny money. Many packages provide a bank reconciliation. You check off the items in the cash book from the bank statement, and then can list out the unpresented items together with any discrepancies that have arisen. A daily bank statement seems desirable to optimise the bank balance. Then, given some pencil and paper work with the amount to be paid into the bank today and available as cleared in three days' time, the amount of cheques that can be drawn today can be computed.

Computerplan makes this a lot easier. A separate account is opened for the bank balance. As the cheques are presented they are keyed in to this bank account and automatically transferred over from the cash book account. Thus at all times you can see both the true position on cheques drawn and paid in, and bank's position on cheques presented.

Debtor and Creditor Control

When funds are short you have to grind the customers harder for payment, and postpone yet again payment for supplies. Aged listings from Sales Ledger and Purchase Ledger are a routine tool for selecting these accounts for attention. Besides these listings, Computerplan has a flexible remittance cycle routine for optimising payments.

Order Control

Having dealt with the cash, the next thing is the customer's needs. A daily review of orders received seems desirable. It is important not to hold up the processing of orders, but a list of orders received should be prepared, up to date, at the end of each day. If there are delays in the handling of the order paperwork at this stage you do have problems. Some packages do not give a very clear day book. They do not have names of customers and products in clear, and it is difficult for management to get an overview of what is going on. The Computerplan listing is in representative order and seems very neat.

Even when the order has been despatched, nothing useful to the company will happen until an invoice has been sent. A list of outstanding orders showing date of order should be available daily. Computerplan provides this for expediting, and also to highlight orders awaiting credit approval, which I guess is yet another aspect not to be forgotten in a rush to sell something to anyone. This list can be selective, before any selected date, or above a specified value, and so on.

Profit versus Cash

There is a conflict between short term cash and long-term profit Pressure for cash to pay the wages on Friday demands that you should sell today any stock that you happen to have on the shelves at any price it will realise Profit at the end of the quarter or end of year demands that when you sell anything it should be at a price that will not only cover its purchase or manufacturing cost but also make a substantial contribution to the overheads and the cost of the money that was tied up to hold it in stock plus a bit more for profit

Either you have a bank manager who is worried today or the same bank manager plus all the investors and shareholders who are very worried at the year end

Even on more relaxed days salesmen will find it easier to sell your product if the price is low, and they like to do this since their commission is likely to depend on sales volume

Do you know how much you can afford to discount your sales prices before you run below purchase cost, or how much contribution to the overheads you have to make on each pound of sales to stay profitable?

If you have consciously decided to sell off stock because it is no longer marketable at the full price then so be it You have decided to take a loss on these specific items In the same way some "marginal costing" could allow you to give away a little of the overhead contribution and all the profit as a loss leader on a limited number of lines a sprat to catch a mackerel you hope, the customer may just feel encouraged to buy some of your more profitable lines at the same time

Most order-entry packages provide sales volumes by product and product group so that you can see from day to day which items are not selling If you also have a stock accounting package then you can see how much is available to be sold off to realise cash, taking care that your beautiful automatic reordering system does not back-order the items at an even higher cost to fuel your cut-price marketing

Profitability by product is hailed by the entrepreneurial businessman as being absolutely the key to success You have to build on your successes What is selling well and profitably today should be encouraged Apart from this, a lot of time should be given to new products for tomorrow but these are not likely to be shown up by the computer Computerplan will as will most of the other order-entry packages, calculate *profits by product* and list them in a useful sequence within product groups

Profit by Customer

By contrast not many businesses try and calculate whether it is worthwhile dealing with individual customers, taking into account price discounts, cash discounts costs of giving credit, delivery, complaints and returns, sales expense, and management time Professional firms do this all the time of course, but traders normally find there is just too much data to be useful It would cost money to analyse the expense to customers, and anyway, no one would have the time to decide what to do about it

Most systems keep turnover statistics by customer Inherently you feel that customers with small turnover are less profitable than bulk customers Depending on the discounts screwed out of you by the bulk customers this could be true. Computerplan keeps *statistics by customers* It can also help analyse all the above costs into sales departments so that you can see whether any particular class of customers is profitable

Cost Control

Let us cut costs This is the ambition of Businessman A, of course but an ambition confined only to the paper handling area Businessman B looks at the admin costs only as part of the total *fixed costs* which will all be reviewed each year hitting the largest items of cost hardest and first

The way to control fixed costs is before they are committed Thus was born the budget, prepared before the year starts, examining each item of cost, but also just why this particular area of the business needs to exist at all

Variable costs are more urgent Any item of cost that is only incurred because an item is sold should be examined with great care Every item that is sold means increasing cost As we generate enormous sales so the costs escalate Even if we sell as a loss leader the costs of manufacture stocking and delivery, are certainly no less

But there are some false economies Every business is full of stories about unjustified savings—like a saving on packaging which doubles the breakages!

On the computer there are two aspects of cost which sometimes conflict Firstly, the total bill for things like telephones is tightly controlled on a company basis A better telephone exchange, with direct inward dialling perhaps or easier ways to transfer calls or a more reliable service or a call monitoring system to remind users that calls cost money particularly in the morning peak period But ultimately the level of telephone use depends on the departments If they want to make sales they have to make appointments on the telephone No calls no appointments, no sales

Analysis of expense for these two conflicting requirements is not easy in most packages Usually you assign separate nominal ledger accounts for each expense in each department Then there are more or less flexible ways to bring the total expense into one sum for the company accounts, and, in parallel, showing department expense in a convenient form for the several individual managers

Computerplan has completely separate Analysis Ledger on an independent 'memorandum basis so that any expense that goes into the nominal ledger in total is also analysed to individual departments or cost centres in the Analysis Ledger This ledger can be printed every-which way so that departments can have the expense they control displayed for management review together with budgets and comparatives for period and year to date

What is not so good is that the Analysis Ledger is not controlled So it is possible to forget to code an expense item to departments and it will just get lost in the company total The Waller plan is to code everything, consciously deciding to code any non-departmental expense to a company cost head A manual check would then have to be made to see that the analysis ledger does control the total amount in the nominal ledger *(See panel for Computerplan comment (1)* Editor)

Once expense has been controlled by budgets then most companies would also create budgets for sales and production, not least because the cost in these two areas is relative to the levels of activity anticipated Variation in sales or production can have a very significant effect on cost per unit sold or produced

New Computer Users Start Here

One of the agonising choices in the small computer marketplace is between the small business system (SBS) vendor and the major manufacturer The SBS vendor is local to you, sells a product which is sold worldwide, with software that looks quite satisfactory and can in addition be customised at very reasonable cost The equipment is available off the shelf and can be installed very quickly The proprietor is helpful and knowledgeable And it costs as little as £6000 installed and ready to run

By contrast the majors sell a very similar product from their standard product range any colour you like as long as it is black, on three months or longer delivery, and it costs £16 000

Yet the eleven major companies continue in business For the record the majors are Burroughs Data General DEC Hewlett Packard Honeywell IBM ICL NCR, Olivetti Phillips, Wang All very well-known names All making similar profits around 20% gross and 10% net and all offering similar service post-sale

The argument is that because the SBS vendor price is so much lower the total service they are delivering must be weaker You must assess how much this means to you bearing in mind the much lower first cost One of the aspects of this decision that I find interesting is that the less expensive SBS offerings are most likely to be purchased by small businesses who are first time users and who are thus not able to appreciate their very considerable need for after-sales support

Major Advantages

The major manufacturers sell through branch offices, typically in the seventeen major cities They are not likely to collapse and indeed spend considerable resources in preserving their good name and reputation to ensure continuing sales in future years.

The product is also likely to be stable and will be on the market for around 5 to 7 years. And the products are normally part of a range, so that newly announced products will be compatible with earlier models. Larger and smaller machines are available in the ranges which are also compatible. Notable among the majors, Data General spend a lot of money making sure that there is a growth path for their customer base and the RDOS operating system is available from the Nova right up to the Eclipse.

Marketing a range of computers also implies that there is a range of disks, printers and displays and other peripheral devices, normally from the same single manufacturer, and which can be upgraded as required. It is a shock that these peripherals are visibly priced at two or three times the price of peripherals on SBS offerings but you will have to steel yourself to the fact that the majors always price that way as part of their bundled service. The buzzword is realistic pricing.

Staff in the majors are generally paid more money and are exposed to a wider range of problems, and should end up with more, and more, relevant experience. Technical and engineering staff from SBS vendors tend to migrate to the majors. There again, however, the proprietor of the SBS vendor is generally very experienced and knowledgeable and was probably with a major before leaving to be king in his own castle.

What you are really buying when you go to a major is quality control. If you are reasonably lucky with an SBS vendor then the product will be fine. But with a major there are established policies in force to see that mistakes occur as seldom as possible, and to move mountains if necessary to correct any boo-boos that do occur.

So there is a standard product sold in a standard way. Any flexibility means increased risk, and the majors are not in the risk business, not for you and certainly not for them. Before an order is taken it has to be signed off by management for hardware, software, support and maintenance. The delivery period is long enough so that any loose ends can be sorted out. The programming languages and testing tools are designed for ease of application development, and because they sell more computers there is more money to pay for this software to be written and documented better. The majors have enough staff and the internal discipline to send the right people to the customer who has a computer problem. It is a formidable package.

Data General

DG are the second largest mini computer manufacturer after DEC. They have sold around 2000 computers in the UK. Besides the seven sales offices they also sell through 200 systems houses, the sort of suppliers known in the trade for no very good reason as OEM's, which is said to mean original equipment manufacturers—which is the last thing any of them do. Incidentally, only 29 of these systems houses are listed in the Which Computer index, which again I find interesting. DG will refer customers to their approved systems houses when anything other than standard off-the-shelf kit is required, and the systems house will take sole responsibility for both hardware and software, if that is what you want them to do.

There are two parallel ranges of hardware. The CS range handles COBOL, and the MicroNova and Nova range handles BASIC. COBOL is a more complex and sophisticated language and has required enhancements to the RDOS operating system which unfortunately do not allow use of BASIC. This tends to lock users into a particular range.

CS10 and MicroNova systems start at around £7000 with floppy disks and extra cost for software. Although a number of floppy based systems are installed, most users tend to install hard disks, the five megabyte-fixed plus five-megabyte-exchangeable disk system being the most popular. Costs for this are in the £16 000 range with two terminals. The Nova 4 systems are all new, with the 4X system being equivalent to the CS50 and about the power of the DEC 11/44.

Computerplan

Being one of the 200 software and system houses basing their offerings on DG hardware, Computerplan both sell in their own right and also supply to 40 other system houses. They are not unique in supplying accounting software on DG systems. There are at least another dozen good packages on offer.

It is significant that most system houses will propose systems rather larger and more powerful than you would expect if you had been dealing with an SBS vendor. The reasons are clear: they do have a range of powerful systems available for sale, they do not want to be blamed for underselling, and at this price range the CPU cost is overshadowed by the cost of the peripherals, the cost of software, and its customising, and the customer's time and effort in getting the system installed.

Computerplan Comments

1) The postings to the nominal ledger are made to the lowest level of account in detail and summary or detailed reports can be obtained. A large number of special reports may be selected and printed using the nominal ledger details. All this would be within the double entry book keeping program.
   The analysis ledger is completely separate and may be set up independent of the normal accounts to provide reports of a different nature such as, say, costing of a contract.
   The nominal ledger is controlled even down to the smallest detail—the software does not allow incomplete entries to be made.
2) The Computerplan Purchase Ledger is not offered on a stand alone basis: it is integrated with the nominal ledger. The latter however is supplied stand alone.
   The costs of modifications depend upon the grade of staff implementing the modifications. Current costs for Computerplan staff are in the range £17–£25 per hour.

Computerplan market ● order entry ● invoicing, ● purchasing ● stock control ● sales ledger ● purchase ledger ● payroll ● general ledger and ● financial reporting. They all integrate together. Indeed, if you do not take the general ledger the accounting controls on the others are a little primitive since the control accounts are set up as nominal accounts. There are industry specialised systems for solicitors, time recording, mailing, subscription accounting, and a word processing package. There is a handy report-formatting package called Dataplan which is quite new but looks useful.

It is likely that the price-list rate of around £750 per package on the MicroNova and £1250 on the Nova 4X would be quoted higher by your supplier to cater for systems work and installation costs on your site. On the other hand, systems houses sometimes use the manufacturer's discount they have obtained, to keep down the total bundled cost for hardware, software and after sales support.

Some of the software is quite sophisticated. Dealers I have spoken to have reported that they have found some bugs, probably in parts of the system that no one else had yet gotten round to using before. Most of these dealers have added on new features that they believed useful, and it seems quite easy to do this. Computerplan state in the manuals that they would anticipate a measure of customising for any user. For the price they are paying the customers want it to be right and do not mind paying a bit more for this.

Typical costs of modification are around £80 per programmer day, and the time to deliver tends to be governed by the time it takes to do this work. Around 90 customers are currently using the Computerplan software, mostly in the BASIC version, some in the COBOL version. *(See panel for Computerplan comment (2).* **Editor**)

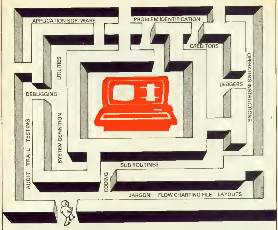
Conclusion

This is not for the smaller user. But anyone with a need for multiple terminals or a requirement for expense analysis and management accounting will rapidly find himself looking at products in this price range. You could do a lot worse than to look here.

A detailed description from me of the software features in Computerplan would not be interesting; anything other packages can do, probably Computerplan can do too. And the cynics in the SBS camp would say that for £7000 software and at least £16 000 hardware, they would jolly well hope so.

A superior product on a good range of machines. ■

● *Richard Waller is with Spicer and Pegler Management Consultants.* **Computerplan** *can be contacted on 01-572 0395.*



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▶ *from page 69*

inverse video, but not half intensity. The board is also fast, it may receive almost 2000 characters per second (video boards are usually fast), and is totally flicker and glitch free. This board is used to drive a 17 inch professional monitor screen and provides a connector for a keyboard.

The keyboard chosen was a Cherry Pro. This is robust, has a positive feel and an ALPHA LOCK key (which is essential for computing jobs other than word-processing). A valuable feature about the keyboard is that there are 5 undefined keys. By trailing a few wires inside the keyboard (get your dealer to do this!), these keys can be made to perform any function. This combination of video board, monitor and keyboard has many advantages, but proper installation requires some specialist knowledge. (It will work with Wordstar configured as an ADM 3A but does not give highlighting.)

A number of video terminals are now available with additional keys specially suited for word-processing. These include Televideo and Cipher, and the Elbit which has a 15 inch screen, and these are worth consideration. It must be remembered that the additional keys can be made to perform some of the special Wordstar functions such as moving the cursor, scrolling up or down, deleting a character or a word, etc. This will probably require a PROM to be programmed and fitted, and this is best done by an expert. Some video terminals have separate keys for moving the cursor. These keys are coded to conform with the ASCII codes for these functions. It should be noted that the codes for cursor movements used by Wordstar are different from the ASCII codes, hence these keys will not work without reprogramming.

High Quality Printers

The three main high quality printers are the Diablo range, the Qume Sprint and the NEC Spinwriter. The first two are daisy-wheel printers and the last is a thimble printer. All give excellent quality printout, since the printed characters are formed from the impact of a moulded character, rather than a combination of dots from a matrix. The style of the printed characters can be changed merely by changing the daisy wheel or the print thimble. This is as easy as changing the golf ball on a typewriter, and the cost is only a few pounds. Carbon film ribbons are available for best quality results, but normal multistrike fibre ribbons are available for routine use. The NEC Spinwriter is marginally the quietest. A new quality printer called the Ricoh is the fastest (60 characters per second).

Conclusion

We have found Wordstar to be an extremely useful package. It is easy to install to one's own equipment using the program INSTALL, it is very easy to learn how to use it, and an impressive list of facilities are available. The documentation is very comprehensive – and at first sight the size of the manual might strike fear into a prospective user. The valuable menus of help which are displayed on the screen make reference to the manual a relatively uncommon event. The only limitation which we have found is that there is no easy way of printing Greek letters or some of the mathematical symbols such as the integral sign. This limitation will not affect the majority of users. ■

- *J D Lee is at the Loughborough University of Technology and T D Lee is at the University of Cambridge*

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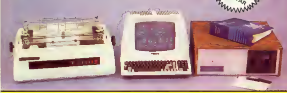

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